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Review

Key Insights from Preflight Planning for Safety Improvement in General Aviation: A Systematic Literature Review

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Abstract: This study highlights the disproportionate number of fatal and non-fatal accidents in general aviation (GA) compared to airline carriers, emphasizing the need to investigate the contributing factors to these incidents. It identifies poor decision-making and a lack of situational awareness as key issues and presents a systematic literature review using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method to analyze preflight information used by GA pilots. The findings underscore the significance of operational factors in ensuring a successful flight and suggest modifications to pilot license renewal processes, with an emphasis on the adoption of digital preflight tools. A new theoretical framework based on the operational factors identified is also introduced, which could serve as a foundation for future studies and interventions aimed at enhancing safety in general aviation.

Keywords: general aviation; preflight planning; decision-making; situation awareness; risk management; PRISMA; systematic literature review

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1. Introduction

General aviation (GA) has been considered the primary school for almost all civil aviation operations. Irwin et al.(2020) [1] consider GA in all areas of civil aviation except scheduled air services and nonscheduled air transport. Still, the accident record is poor compared to airline operations [2]. While air carriers have improved the accident safety record in the last decades, GA, despite a modest decrease in the accident rate in the previous few years, is still >60 times higher than the accident rate [3]. Prior research has highlighted poor preflight planning routines and a deficient understanding of aviation meteorological conditions as critical elements contributing to the disproportionately high accident and fatality rates observed among beginner private pilots [4]. These disparate numbers in safety records between airlines and GA operations probably reflect multiple factors [3]. Almost 80% of aviation accidents occur in GA, mainly attributed to the pilots' poor ability to maintain situational awareness, which affects their ability to ensure a safe and efficient flight [5,6]. Boyd et al. (2021) [3] argue that some causes are attributed to these differences in safety records, namely between private pilots' and aircraft carriers' license requirements. While airline crews must undertake mandatory training every 6 months, a flight review for GA pilots is only required once every 24 months. Furthermore, airline pilots' training programs typically include a multi-day program involving air maneuvers, abnormal procedures, line-oriented flight training, and upset recoveries. In contrast, for general aviation airmen, a flight review requires only 1 h of training, and flying tasks are at the sole discretion of the instructor pilot [3]. Nevertheless, airline pilots' training should be reviewed regarding psychological arousal, information processing, and performance [7]. Aviation pilots must always present a risk assessment while performing many tasks, such as equipment, environmental procedures, and colleagues, as well as the effects of their responses [8]. Preflight planning is the first task before each flight. Pilots consider this information gathering a vital aspect of flight preparation [1]. Preflight decisions are all the tasks performed before taxiing the airplane onto an active runway to take off [9]. Smith (1994) [10] discusses the importance of adequate preflight planning in minimizing accidents in the general aviation community, highlighting the need to reexamine the preflight/weather briefing market involving federal, state, and commercial vendors to improve services and encourage better preflight preparation. Also, [11] highlights the importance of new preflight contributory factors with a new framework. The preflight briefing is vital from a safety standpoint, encompassing human factors and an operational viewpoint [12]. From the safety perspective, this procedural step is instrumental in ensuring the flight crew comprehensively identifies, deliberates upon, and mitigates the intricacies and potential hazards pertinent to the imminent flight [13]. There are still only a few studies that evaluate all the preflight conditions regarding, for instance, risk management, mass and balance, and performance calculations and relate them to the inflight phase. There is a gap in describing all the operational contributing factors involved inflight planning and connecting them to safety risk management and a successful mission. This systematic literature review intends to provide a comprehensive picture of how GA pilot's use the available preflight information for a successful mission and contribute to further discussion on its impact on the remaining phases of the flight. It also contributes to better risk management comprehension, improving safety measures and lowering GA accident rates. It starts by describing the research methodology and how the references are chosen. Next, we provide a qualitative and quantitative bibliometric analysis. The final section presents conclusions, limitations, and further work.

2. Methodology

The research uses the PRISMA [14] approach. The most relevant articles were selected with a timespan from 1975 to 2023, representing 48 years of published literature. The following research engines were accessed: Scopus [15], ISI Web of Knowledge [16], Sage [17], ACM Digital Library [18], Science Direct [19], and IEEE Xplore digital library [20] (all accessed on 3 March 2024). These scientific databases retrieved 289 publications (11 from WoS, 27 from Scopus, 24 from IEEE, 31 from Science Direct, 37 from ACM, and 159 from SAGE). One paper was added to the collection to support the explanation of the Circos diagram [21]. From the databases selected, 192 publications were removed (3 from WoS, 13 from SCOPUS, 12 from IEEE, 13 from Science Direct, 35 from ACM, and 116 from SAGE) due to being duplicates, proceedings that were out of scope, books that were out of scope, and abstracts or content that were out of scope. Figure 1 shows the PRISMA information flowchart.

The search used for paper selection from databases was based on keywords ("general aviation", "preflight planning", "decision-making", "situation awareness", and "risk management"). By reviewing the abstracts and content of the papers, we selected the most important studies for each database's final score. In the next step, all proceedings articles, duplicates, and out-of-scope articles from each database were removed. After merging the results, all the duplicates found in the final score were removed. The eligibility of the papers was assessed by assessing the subject in the abstract and comparing keywords with the ones used in the research queries. The introduction content was also reviewed, as well as the methods used and conclusions obtained. Appendix A shows the specifications of the articles in the journals obtained by journal title, source, country, publisher, h-index, and quartile provided by Scimago Journal and Country Rank [22]. Bibliometric analysis was conducted using Endnote [23] and Circos [21] software. Vosviewer 1.6.20 software [24] was used to conduct qualitative and quantitative data network analysis regarding keyword occurrence-based bibliometric maps.

Table 1 shows the results of the research questions made in the databases. We searched "ANYWHERE" in the SAGE database because only three studies were obtained in the abstract field if we searched only the title abstract or keywords. Due to the limitation of using eight boolean operators in the Science Direct Database, we split the query into two sub-queries, for which we joined the sets and discarded duplicates. Due to the limitations of this search engine using title, abstract, and keywords in the ACM Database, we used "ALL".

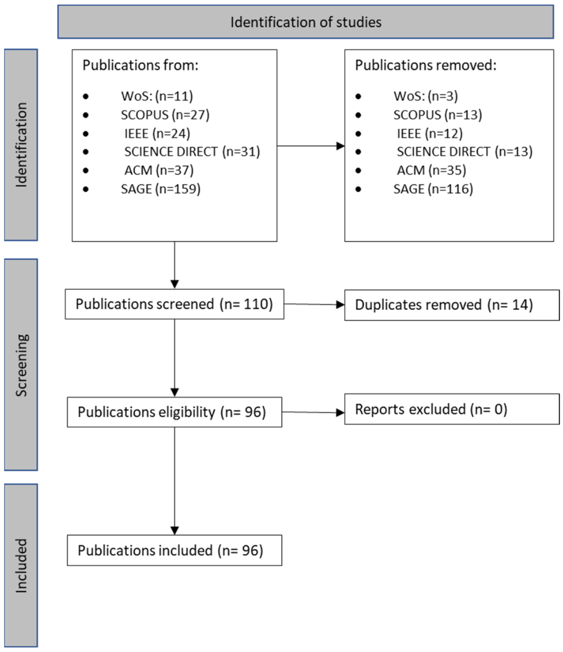

Figure 1. PRISMA information flowchart.

Table 1. Queries results in databases.

Database	Query	Total	Excluded	Motive	Results
WoS	ts = ("general aviation" and (((situation or situational) and awareness) or ((preflight or preflight) and (plan or planning))) and ("decision making" or "risk management"))	11	3	Proceedings out of scope	8
SCOPUS	title-abs-key ("general aviation" and (((situation or situational) and awareness) or ((preflight or preflight) and (plan or planning))) and ("decision making" or "risk management"))	27	13	Proceedings out of scope	14
IEEE	("all metadata": "general aviation" and (((situation or situational) and awareness) or ((preflight or preflight) and (plan or planning))) and ("decision making" or "risk management"))	24	12	Proceedings out of scope	12
Science Direct	("general aviation" and (((situation or situational) and awareness) or ((pre-flight or preflight) and (plan or planning))))	28	7	Out of scope	31
	("general aviation" and ("decision making" or "risk management"))	16	6	Duplicate	
ACM	[all: "general aviation"] and [[[[all: situation] or [all: situational]] and [all: awareness]] or [[[all: preflight] or [all: preflight]] and [[all: plan] or [all: planning]]]] and [[all: "decision making"] or [all: "risk management"]]	37	4 2 3 26	Out of scope book Duplicate proceedings	2
SAGE	[all "general aviation"] and [[[[all situation] or [all situational]] and [all awareness]] or [[[all preflight] or [all preflight]] and [[all plan] or [all planning]]]] and [[all "decision making"] or [all "risk management"]]	159	2 73 41	Duplicate proceedings Out of scope	43
Total		302	192		110
	Duplicates removed from all databases		14	Duplicate	
Final	After excluding duplicates and proceedings from all databases	302	206		96

A content analysis was performed to understand the main topics from the publications retrieved. This content analysis allowed the creation of acronyms, as shown in Table 2.

Table 2. Acronym description according to literature.

Acronym	Description	Topic	Authors
SA	Situational awareness	The concept is described as "*the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future*".	[25,26]
PE	Performance	The concept is described as a consequence of doing an inflight or preflight task.	[27]
HM	Human–machine	The concept is described as systems that enable people to be effective in the complex aviation environment.	[28]
WR	Weather	Weather planning and implications to the weather flight planning.	[29]
RM	Risk management	The concept is described as the risk assessment for preflight and inflight planning.	[8]
PF	Preflight	All the preflight tasks associated with preflight planning.	[28]
TG	Training	The topic is described as pilot training and the ability to cope with an unexpected situation.	[3]
SF	Safety	Described as all components involving flight safety.	[30]
HR	Human error	Human error in performing tasks while on preflight or inflight.	[31]
DM	Decision-making	The topic is described as pilot decision-making and the ability to cope with an unexpected situation.	[32]

From Table 2, we see that for the search queries in question, the literature focuses on the following concepts: situation awareness (SA), performance (PE), human–machine interaction (HM), weather (WR), risk management (RM), preflight (PF), training (TG), safety (SF), human error (HR) and decision-making (DM). In Figure 2, we relate the acronyms previously shown in Table 2 to a time publication reference, which are called contributing factors from now on. Figure 2 illustrates the frequency of each factor according to searches made in the referred databases. The chart clearly shows the presence of the contributing factors in the literature. Using the aesthetic information software Circos 0.69–9, we built a circle diagram to visualize the elements [21]. The timeline (right-hand part) shows the results from 1975 until 2023, and the left-hand part shows the contributing factors. To connect these two sides of the Circos diagram, we colored ribbons, which relate each factor's publication amount to the corresponding time interval. A 3-year time interval was selected for better visualization of the results.

The widths of the colored ribbons indicate more publications by contributing factors per time. The Circos diagram was constructed with the bibliometric study of the publications for the most relevant determining factors found in the literature (left-hand side of the semicircle): SA, PE, HM, WR, RM, PF, TG, SF, HR, and DM. Figure 2 shows that DM (red) and SF (light green) are the most mentioned determining factors in the research. The red (DM) and light green (SF) relationship between the contributing factor and all-time intervals can be seen. DM ribbons (red) are balanced, except in 1991–1993 and 1985–1987. SF ribbons (light green) are always presented as a significant factor through the years of research. PE (orange) also shows a prevalence in selected years but with fewer papers. The other seven contributing factors, HM (light red), HR (dark orange), PF (light orange), RM (yellow), and SA (yellow-green), are of equal importance, although some are less frequent. The right-hand side semicircle clearly shows that the earliest years, 1973–1981, are low in publications, and DM, WR, and SF were the first contributing factors that appeared. PF first appeared in 1985–1987; it was not a common contributing factor explored in the literature in the following years. This leads to the idea that DM and SF were the most critical determining factors regarding the flight characteristics evaluation process. The most often returned contributing factors were decision-making (DM), safety (SF), performance (PE), weather (WR), training (TG), and situational awareness (SA), whereas preflight (PF), human error (HR), and risk management are the less returned factors, showing that these should be studied in-depth when investigating preflight planning.

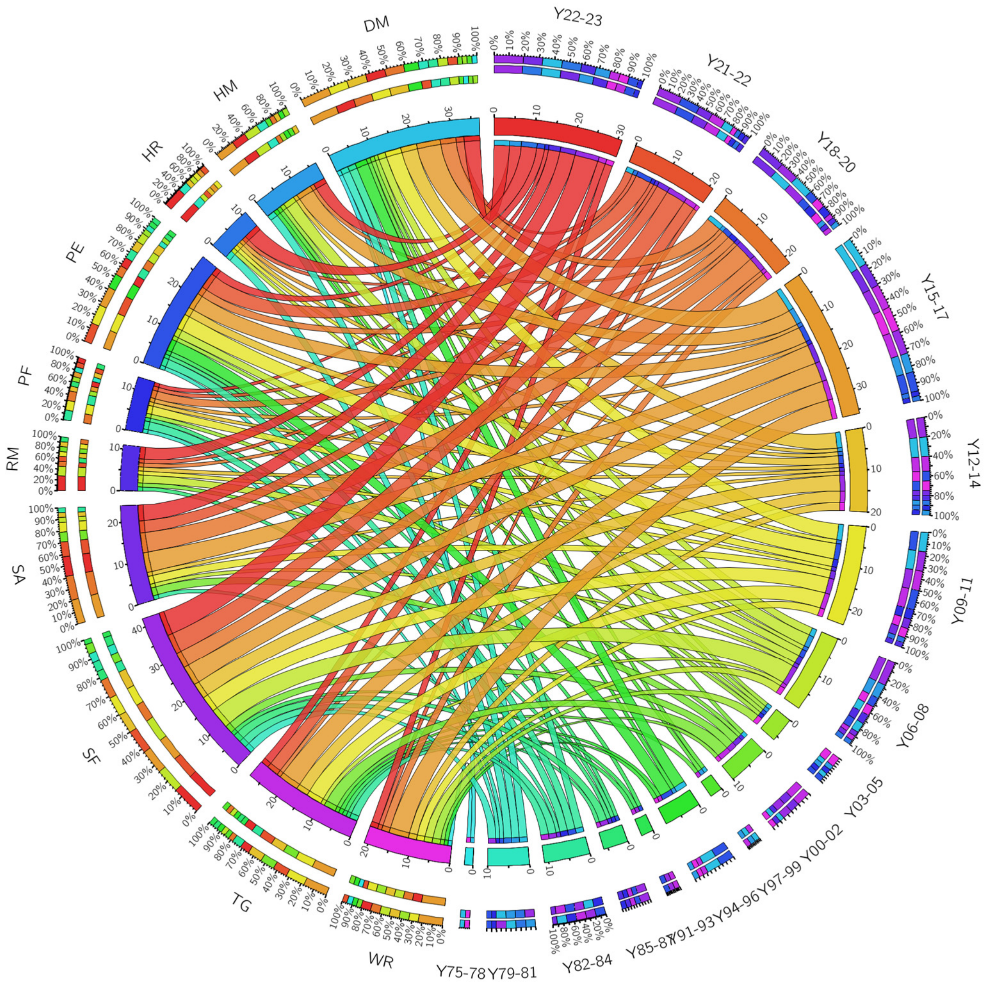

Figure 2. Contributing factors related to the time reference.

3. Bibliometric Analysis

3.1. Keyword Analysis

We also performed a keyword analysis with VOSviewer to visualize scientific landscapes based on the keyword co-occurrence data of our study results. Figure 3 presents a bibliometric network visualization showing the keyword occurrence. Co-occurrence author keywords were selected using the software and the full counting method. We obtained 398 keywords with a threshold of 1, with a linlog/modularity normalization method. The central theme, 'aviation', suggests that the surrounding keywords are related to research within the aviation field. Clusters of keywords are differentiated by color, indicating thematic groupings. The lines connecting the nodes represent the relationship's strength, with a higher number of lines indicating a stronger association. The size of the nodes corresponds to the frequency of the keyword's appearance in the dataset, and larger nodes such as 'aviation', 'general aviation', and 'decision-making' were more prevalent. Of the 398 keywords, we selected the 20 with the high link strength, as shown in Table 3. In summary, the visualization comprehensively represents the relationships between keywords in aviation research, showing the frequency and connection strength of terms within the field. It is an effective instrument for identifying research trends, prominent topics, and potential gaps in the literature.

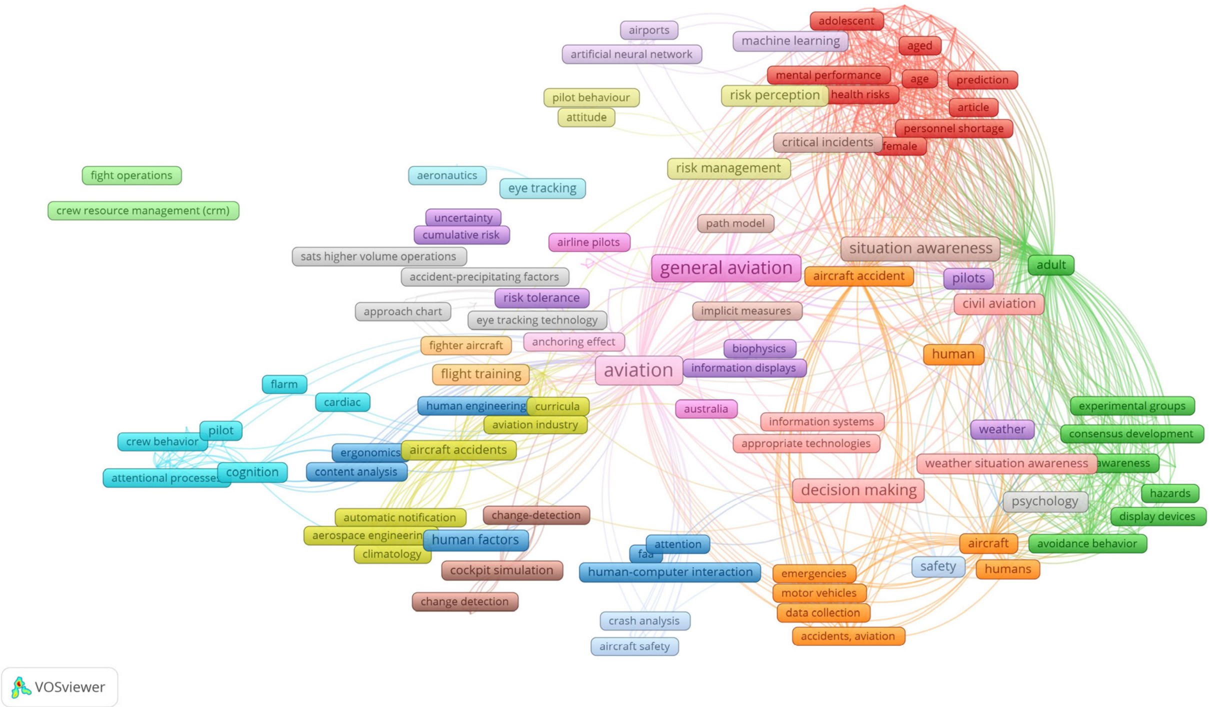

Figure 3. Keyword occurrence using network visualization.

Table 3. Keywords with the highest link strength.

Nr	Keyword	Link Strength	Occurrences
1	Aviation	417	39
2	General aviation	324	30
3	Situation awareness	297	18
4	Human	294	9
5	Decision-making	287	21
6	Civil aviation	267	9
7	Pilots	264	9
8	Adult	234	6
9	Airplane pilot	234	6
10	Safety	203	12
11	Risk management	195	9
12	Aircraft accident	183	6
13	Aircraft	171	6
14	Humans	171	6
15	Risk perception	155	11
16	Machine learning	150	6
17	Weather situation awareness	144	6
18	Weather	141	6
19	Critical accidents	138	6
20	Pilot performance	129	6

Table 3 shows that the keywords "general aviation", "situation awareness", "human", "decision-making", "civil aviation", "pilots", "adult", "airplane pilot", "safety", "risk management", "aircraft accident", "aircraft", "humans", "risk perception", "machine learning", "weather situation awareness", "weather", "critical accidents" and "pilot performance" have a significant role in aviation with 39 occurrences and a 417 link strength. From the network visualization of the occurrence of keywords (Figure 3), we also performed a keyword occurrence using year overlay visualization (Figure 4).

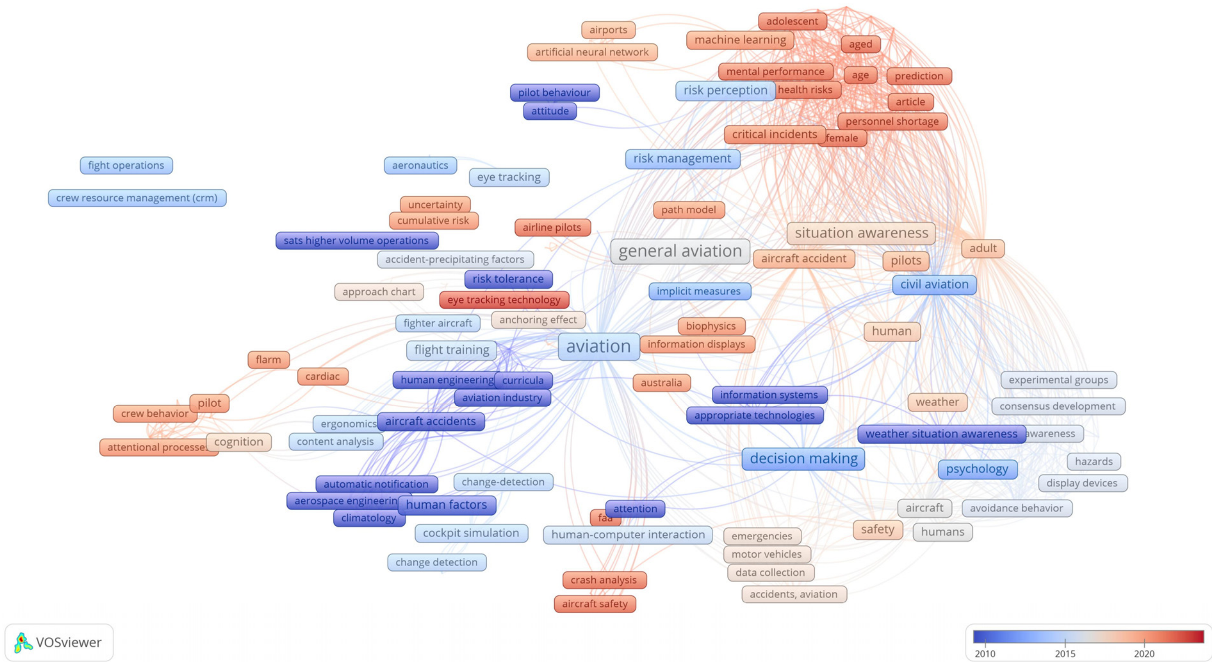

Figure 4. Keyword occurrence using year overlay visualization.

Figure 4 is a bibliometric visualization also created with VOSviewer, mapping out key relationships between terms by year in the aviation research literature obtained in our study. The largest nodes—'aviation', 'general aviation', and 'decision-making'—indicate these are the most researched and yearly discussed topics. The interconnections between terms like 'human', 'cognitive health', and 'psychology' point toward a significant focus on human factors in aviation. Safety concerns are highlighted by the cluster of terms associated with 'safety', 'risk management', and 'aircraft safety', indicating a strong emphasis on identifying and managing risks.

There is a clear trajectory of integrating technology into aviation, evidenced by terms such as 'artificial neural network' and 'machine learning'. The inclusion of 'weather' and 'COVID-19' suggests that external factors and their impacts on aviation are of growing interest in the literature. The timeline at the bottom, with lines extending to various years, reveals how these themes have become more or less prominent over time; for instance, 'COVID-19' is a term that spiked in relevance in recent years.

The visualization also serves as a research tool to identify trends, emerging topics, and potential gaps in the literature where thinner connections or smaller nodes appear. Furthermore, the network indicates interdisciplinary research connections, integrating insights from technology, psychology, and health into the field of aviation. This bibliometric map is invaluable for researchers and policymakers to understand the current state of aviation research, to follow its evolution over time, and to identify areas that may require further exploration.

Based on the keyword-by-year overlay visualization in Figure 4, the leading ten clusters are identified in Table 4. From Figure 4, we extracted a .csv map file with VOSviewer and analyzed the keywords with a total link strength more significant than 16, with a minimum of two occurrences. This analysis allowed us to find the most critical keywords in the literature from the database algorithm results. Table 4 shows the results of the study.

Table 4. Identification of top keywords in clusters by knowledge area.

Clusters	Keywords
Aviation	"accident rate", "aerospace engineering", "aircraft accidents", "approach chart", "automatic notification", "aviation", "aviation industry", "climatology", "complexity", "curricula", "distractions", "errors", "federal aviation administration", "flight dynamics", "flight training", "human in the loop simulation", "intelligent agents", "key elements", "learner-centered", "methods", "minima", "monitoring", "resource management", "risk analysis", "scanning", "scenario-based training", "situational awareness", "training curriculum", "training programs", "weather conditions", "weather forecasting", "weather-related accidents."
General aviation	"appropriate technologies", "change-detection", "cockpit simulation", "convective weather", "design guidance", "eye-tracking", "functional near-infrared(fnir) system", "general aviation", "information systems", "information use", "perceived utility", "symbols", "usability evaluation", "visual meteorological conditions (VMC)", "weather avoidance", "weather display", "weather information"
Human factors	"attentional processes", "aviation and aerospace", "cardiac", "cognition", "content analysis", "crew behavior", "ergonomics", "eye movements", "faa", "fatigue", "headset", "heart rate"„ "human-computer interaction", "human factors", "interface design", "machine vision", "motor behavior", "performance", "psychological and psychological conditions", "pilot", "pilot-cockpit systems", "sensor-based vision system", "simulation", "simulation and training", "skilled performance", "stress", "tracking", "training"
Critical accidents	"adolescent", "age", "aged", "aircraft accident", "article", "attitude", "cognition assessment", "cognitive factors", "cognitive health", "cognitive screenings", "critical accidents", "cyber sickness", "female", "fuel management", "health risks", "health screenings", "learning algorithms", "low-level flying", "machine learning", "machine learning classification", "male", "mental performance", "older adults", "passenger safety", "personality", "personnel shortage", "pilot behavior", "prediction", "professional competence", "risk assessment", "risk identification", "risk management", "risk perception", "risk-taking", "sensitivity and specificity", "simulated flight", "virtual addresses", "virtual reality", "virtual reality cognitive tool", "workload"
Decision-making	"adult", "aircraft", "airplane pilot", "civil aviation", "decision making", "human", "pilot performance", "psychology", "safety", "situation awareness", "weather", "weather situation awareness", "avoidance behavior", "awareness", "consensus development", "control group", "controlled clinical trial", "display devices", "experimental groups", "experimental model", "flight display", "hazards", "meteorological problem", "meteorology", "mobile application", "mobile devices", "navigation", "oxygenation", "oxygenation levels", "pilots", "potential benefits", "psychology", "randomized controlled trial", "task performance", "task performance and analysis", "visual meteorological conditions.", "Aeronautical decision-making"
Risk management	"biophysics", "cumulative risk", "decision-making", "experimental medicine", "flight", "information displays", "nexrad", "probabilistic estimates", "public environmental and occupational health", "research", "risk situation awareness", "risk tolerance", "uncertainty", "usability", "weather hazards"
Intelligent decision-making	"accidents aviation", "data collection", "emergencies", "emergency", "inflight decision-making", "information processing", "mass media", "mass medium", "motor vehicle", "news archives", "power lines", "united states", "wounds an injuries."
Task management	"crew resource management", "flight operations", "flight crew", "information flow", "procedures", "process", "reporting", "safety management", "task", "threat and error management (TEM)", "workflow."
Safety	"aircraft safety", "crash analysis", "crash data", "emergency management", "general", "hazard analysis", "pilot safety", "safety performance and analysis", "security and emergency", "Safety Capacity", "Safety-II"
Information management	"airports", "artificial neural network", "atmospheric modeling", "modeling", "Petri nets", "predictive models", "prototypes", "tools"

Table 4 shows the clusters' main areas or top keywords regarding the database algorithm results. The main subjects involved from the keywords with a total link strength more significant than 16, with a minimum of two occurrences, are "aviation", "general aviation", "human factors", "critical accidents", "decision-making", "risk management", "intelligent decision-making" "task management", "safety", and "information management". The next step was to analyze the occurrence of the keyword by year. Figure 4, shows the main clusters in the dataset using year overlay visualization. In recent years, most of the literature has focused on analyzing the human factors in general aviation regarding aircraft accidents, risk management, risk perception, professional competence by pilots, and cognitive factors. Nevertheless, there are some crucial issues regarding situation awareness in general aviation. These previous analyses show a gap in the literature regarding the lack of studies between the preflight planning and inflight phases.

3.2. Content Analysis

This systematic literature review intends to provide a comprehensive picture of how GA pilots use the available preflight information to ensure a successful mission and contribute to further discussion on its impact on the remaining phases of the flight. From previous results, we showed that the most important subjects of the keyword analysis were "aviation", "general aviation", "human factors", "critical accidents", "decision-making", "risk management", "intelligent decision-making", "task management", "safety", and "information management". In this work, we analyzed 96 papers from 1976 to 2023, searching for the main contributing factors of preflight planning. Figure 5 shows the trend of article numbers extracted with the research algorithm in the selected databases. It shows the total number of articles extracted using the PRISMA approach. A tendency line was added to the graph.

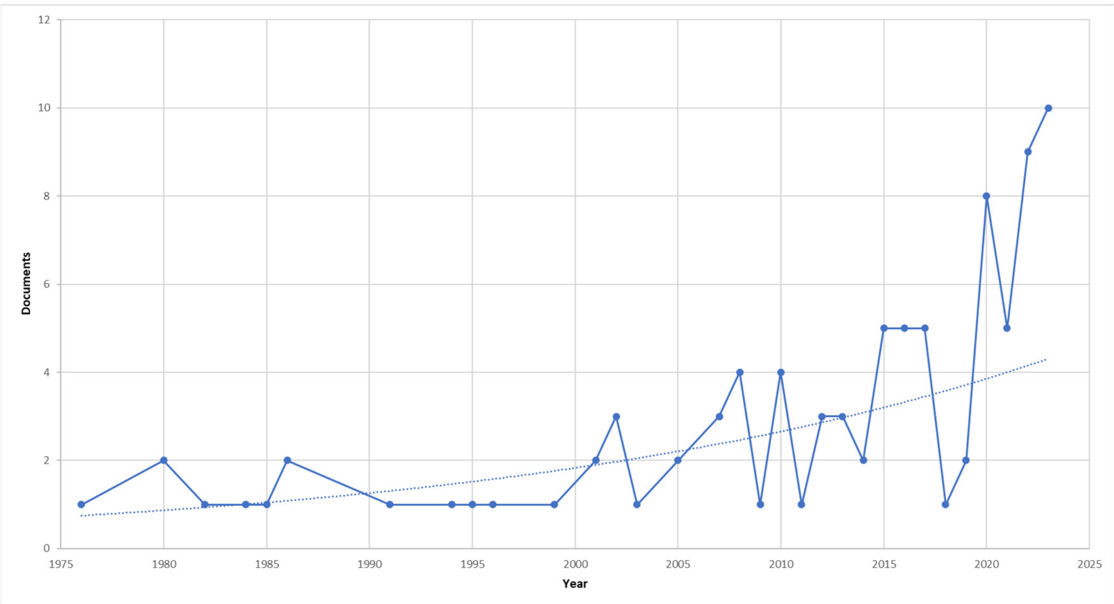

Figure 5. Trends in document occurrence from 1975 to 2023.

Figure 5 shows that since 1975, there has been a growing concern around keyword research, with the peak of the paper number over the last years belonging to 2022, with eight articles published. We also performed a journal specifications analysis, accessing Scimago Journal and Country Rank, where we extracted the journal title, source, country, publisher, h-index, and quartile of the publication (Appendix A). Appendix B shows the 30 most cited articles. It also shows each study's description, methodology, and conclusions.

In our timespan research, no documents were retrieved from 1975. After that, throughout the first 5 years, between 1976 and 1981, the literature focused on analyzing weather forecasting for decision-makers [33] with the first studies regarding a human error with two facets involved, the pilot and the air traffic control (ATC), with a focus on their performance and flight safety [34]. Ref. [35] developed a simulator experience involving both ATC and pilots where a new cockpit displays traffic information that could help the workload and improve the performance of pilots and ATC, augmenting flight safety. He concluded that the automated use of these tools could increase flight safety and reduce the workload on pilots and ATCs. Safety has always been a significant concern for flying activities. From 1982 to 1986, the focus was on evaluating the main factors contributing to aircraft accidents. Decision-making and pilot judgment were the focus of the research [36,37]. Accident analysis, experimental design, and cognitive theory concluded that flight training modifications were necessary to improve flight safety. Cognitive skills became an essential factor in analyzing why so many accidents happen. Childs and Spears (1986) [38] concluded that recurrent training is necessary to identify flight-skill decay and maintain cognitive skills adequate when flying an airplane. Furthermore, Boyd et al. [3] considered that GA pilots' training/recurrency should focus on unusual attitude recovery and managing approach speeds. Jones and Wuebker [39] tried to understand how employees embrace safety issues in a similar industry where the dynamic environment requires trained cognitive skills.

Exploring accident causes became an essential issue that researchers explored from different perspectives. For instance, Marske (1986) [40] concluded that creating a sociological analysis of air disasters improves flight safety. The main contributing factor for a broader accident analysis appeared in the literature. New training evaluations with simulator experiences started to highlight the main problems within the cockpit. Communication between aircrews and workload were analyzed, adopting several procedures from military aviation [41,42]. Aviation became an industry where all fields of Science could contribute regarding safety. Cognitive factors, psychological issues, situational awareness, training, technology, and ergonomics were now trying to deepen and understand [43,44]. Glockner (1996) addressed new ways to optimize traffic flow with a new framework model for the congestion-delay traffic problem. According to McLean [45], human factors and controlled flight into terrain were the two significant causes of aircraft accidents. McLean [45] suggested that a new avionic cockpit system and training schemes improved the pilot's ability to minimize human factors and avoid an unrecoverable flight. Challenges regarding flight training with the crew resource management (CRM) program were discussed by [46]. Nevertheless, [46] argued that the impact of CRM cannot be truly determined.

One of the major causes of accidents is a pilot's decision to continue to fly using visual flight rules (VFR) into adverse weather or instrument meteorological conditions (IMC) [47]. Pilots' poor evaluations of weather conditions before and during flight have been a crucial factor that often results in an accident. [48] argue that weather situation awareness can be improved with a graphical weather information system (GWIS). They concluded that the GWIS had improved pilots' decision-making and weather situation awareness. Creating cues is essential at the cognitive level regarding pilots' weather decision-making. Training becomes crucial to provide pilots with the skills to recognize these cues associated with deteriorating weather conditions [49]. Workload reduction is also possible with these graphical weather assistant tools in preflight and inflight procedures [50]. Applying a set of human factors and ergonomics led to a much-improved display interface with improvements in human performance [51].

Nevertheless, the design and acceptance of novel display formats of meteorological information must be subject to pilot training to interpret the device reasonably [52,53]. Despite new applications using weather information to automatically show hazardous conditions and alert pilots of a potential weather conflict, the weather display symbology affects pilot behavior and decision-making [29,52]. Pilots' portable weather applications are recurrent in most general aviation flights. Pilots can use these mobile weather applications without affecting cockpit performance [53]. There is also little difference between the interpretation by pilots of the images provided and the traditional human-in-the-loop polygon products [54]. Weather and weather planning are still hot topics that literature focuses on nowadays, with the merging of several theories to understand why pilots fly into adverse meteorological conditions [27].

The human–machine factor is also a significant subject in the literature. Strauch [31] argued that including automation in training programs can reduce opportunities for automation-related errors. Some authors relate cognitive skill degradation to the frequent use of automation [28]. Boyd et al. [3] stated that airline pilots should seek additional instruction regarding flying general aviation aircraft. A recent study also concluded that new strategies are needed to address deficient aeronautical decisions by GA pilots [55]. As mentioned before, the lack of cognitive skills was one of the main factors to analyze in an aircraft accident. Nowadays, some authors argue that automation can influence the ability of a pilot to fly an aircraft manually [3].

4. Conceptual Framework

The conceptual framework depicted in Figure 6 synthesizes the main clusters identified in Table 4 and discussed earlier in this paper, illustrating critical factors influencing preflight planning for general aviation (GA) pilots. The arrows in the conceptual framework indicate a linear directional flow progression from “aviation” to “information management”, which shows the steps involved in a typical aviation operation, from general concepts to specific areas. This mirrors the logical structure in the table, where each cluster represents a stage in aviation with keywords covering associated concepts. Starting from “aviation” and moving through “general aviation”, “human factors”, and so on, it suggests a pipeline of information processing and decision-making. The keywords in the table reflect various types of data, such as “flight dynamics”, “general aviation”, and “situational awareness”, emphasizing the importance of information flow. The flowchart’s path also suggests an increasing focus on safety and risk management as operations progress. The transition from “critical accidents” to “decision-making” and “intelligent decision-making” aligns with the table’s keywords, indicating a logical flow toward enhanced safety and risk mitigation. The arrows represent addressing risks, learning from critical accidents, and implementing decision-making strategies to improve safety. The flowchart’s connections signify the interdependence of various aviation elements, from training and human factors to task management and information processing. The keywords in the table, like “resource management”, “crew behavior”, “risk analysis”, and “task”, emphasize this interconnectedness, showing how different systems within aviation are related. The sequence indicates a workflow for aviation operations, highlighting the step-by-step process from departure to arrival. This flow reflects the transition from broader aviation concepts to specific safety and information management aspects. The table’s clusters and keywords support this idea, with keywords like “workflow”, “training curriculum”, and “situational awareness” showing a structured operational process. Finally, the arrows connecting the flowchart’s stages can represent a logical flow in aviation operations, from general to specific concepts, focusing on information flow, risk management, interconnected systems, and operational workflow. The table’s keywords align with this structure, illustrating the diverse elements involved in aviation and how they are logically connected.

This framework captures the key dimensions the GA pilots must navigate to ensure a safe and effective flight from departure to arrival. It highlights the multifaceted nature of preflight planning and underscores the various aspects, such as decision-making and task management, which can profoundly impact flight safety. This framework also addresses the following problems by dimension, namely: aviation/general aviation (type of flight visual VFR or instrument IFR, weather stability, aircraft visual inspection, aircraft performance, mass and balance calculations, day or night flight, highest crosswind); human factors (rest in the last 24 h, previous meal, duration of the flight, hours in aircraft type, hours in the previous 90 days, aircraft proficiency); critical accidents (history of accidents in aircraft type, route and destination), decision-making (go/no go); intelligent decision-making (satellite charts, digital preflight tools); task management (all tasks are straightforward for the crew or solo pilot); safety (all preflight briefings are executed); and information management (all information regarding preflight is acquired). By enumerating these dimensions, this framework helps pilots and flight institutions/companies address these critical steps during preflight planning in a comprehensive, logical, and safer manner.

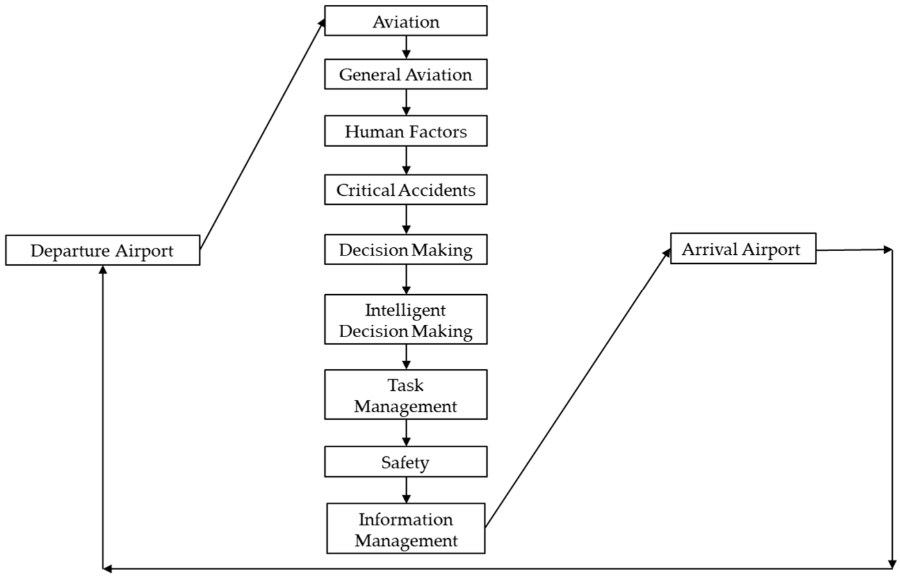

Figure 6. Conceptual framework for preflight planning.

General aviation, characterized by a higher incidence of accidents than other aviation categories, necessitates a deeper investigation into these contributory factors. The failure to adequately address any of the outlined dimensions could significantly escalate the risk of an incident or accident. This visualization thus serves as an essential tool for understanding the complexities GA pilots confront in the dynamic environment of aircraft operation. Further research is imperative to expand our comprehension and enhance the safety protocols within this sector. The "Conceptual Framework for Preflight Planning" also visually represents information or data (charts, graphs, maps, diagrams, digital tools) and any other visual tools that aid inflight planning. It is also a structured approach to preparing for a flight, as it encompasses all critical factors a pilot must consider, including weather analysis, air traffic, flight routes, aircraft performance, and safety protocols, highlighting the constantly changing conditions within which GA pilots operate. Finally, this conceptual framework strengthens GA's safety protocols by increasing pilots' awareness of preflight briefing.

5. Conclusions

This study follows a systematic literature review on general aviation (GA) preflight conditions and planning to better understand the contributing factors of a successful flight. Our literature review shows there are only a few studies about the preflight information stage. Most existing research disproportionately focuses on inflight challenges such as adverse weather conditions, diminished situational awareness, and suboptimal risk management by pilots, with scant attention to the preflight phase. Our findings suggest that many weather-related accidents could potentially be prevented with robust preflight planning, underscoring the necessity for enhanced focus in this area. The main dimensions found in this study were identified and gathered in a conceptual framework for preflight planning, which shows the main dimensions a GA pilot must address to perform a successful flight.

A particular observation is the delineation between increased automation and the deterioration of pilots' cognitive abilities. This intersection warrants further exploration, particularly concerning how automation's convenience could inadvertently contribute to skills attrition. In response to these insights, we propose a paradigm shift in GA flight license renewal criteria to follow the same criteria for commercial airlines. Current renewal processes should evolve, incorporating comprehensive proficiency checks, which extend beyond practical skill evaluation to include a robust assessment of theoretical knowledge in meteorology and proficiency in using advanced digital tools for flight planning. This shift is not merely a recommendation; it is a call to action for regulatory bodies and training institutions to reconsider and revamp licensing criteria, thereby harnessing the power of technology to enhance pilot preparedness and flight safety. This study not only sheds light on the overlooked aspects of preflight planning in GA but also charts a course for future research and practice aimed at bolstering flight safety. By reimagining licensing criteria and harnessing the power of technology, the aviation community can make significant strides in enhancing pilot preparedness and, consequently, flight safety.

In our study, a primary limitation encountered was the variability in the capability of search engines, which led to discrepancies in research queries. Applying operational research principles and artificial intelligence tools in preflight planning presents a promising frontier. These technological interventions hold the potential to significantly augment pilots' ability to interpret and act on preflight information, thereby elevating safety standards in general aviation. Reflection on the limitations and findings of this study suggests that future research must adopt more sophisticated search strategies to ensure a comprehensive capture of relevant literature. Additionally, further investigation should critically assess the current imbalance in aviation safety research, aiming to develop more holistic safety protocols encompassing both preflight and inflight phases.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare conflicts of interest.

Appendix A. Journal Specifications

Nr	Journal Title	Source	Country	Publisher	H-Index	Quartiles
1	Social Studies of Science, 6(1), 5–31	Journal	UK	Sage Publications Ltd.	89	Q1
2	Human Factors, 22(5)	Journal	USA	Sage Publications Inc.	117	Q1
3	Human Factors, 22(6), 671–691	Journal	USA	Sage Publications Inc.	117	Q1
4	Human Factors, 24(1), 61–73.	Journal	USA	Sage Publications Inc.	117	Q1
5	Human Factors, 26(5), 557–564.	Journal	USA	Sage Publications Inc.	117	Q1
6	Perceptual and Motor Skills, 61(1), 151–161.	Journal	USA	Sage Publications Inc.	69	Q3

7	Perceptual and Motor Skills, 62(1), 235–242.	Journal	USA	Sage Publications Inc.	69	Q3
8	Journal of Sport and Social Issues 10, no. 2 (1986): 6–26	Journal	USA	Sage Publications Inc.	57	Q1
9	Human Factors, 33(6), 677–691.	Journal	USA	Sage Publications Inc.	117	Q1
10	Ergonomics in Design, 2(2), 13–18.	Journal	USA	Sage Publications Inc.	21	Q4
11	IFAC Proceedings Volumes, 28(15), 353–358.	Conference	USA	Elsevier	n.a.	n.a.
12	Transportation Research Record, 1517(1), 29–36.	Book Series	USA	US National Research Council	119	Q2
13	Ergonomics in Design, 7(3), 4–9	Journal	USA	Sage Publications Inc.	21	Q4
14	Measurement and Control, 34(1), 14–18.	Journal	USA	Sage Publications Inc.	21	Q3
15	Human Factors, 43(4), 641–674.	Journal	USA	Sage Publications Inc.	117	Q1
16	SAE Technical Paper. (No. 2002-01-1521)	Journal	USA	SAE International	107	Q2
17	Human Factors, 44(2), 171–188.	Journal	USA	Sage Publications Inc.	117	Q1
18	Human Factors, 44(2), 189–197.	Journal	USA	Sage Publications Inc.	117	Q1
19	Human Factors, 45(2), 337–345.	Journal	USA	Sage Publications Inc.	117	Q1
20	Reviews of Human Factors and Ergonomics, 1(1), 89–129.	Book Series	USA	Sage Publications Inc.	17	Q4
21	Journal of Aerospace Information Systems, 2(9), 386–400.	Journal	USA	American Institute of Aeronautics and Astronautics Inc. (AIAA)	33	Q2
22	Applied Ergonomics, 38(4), 465–471.	Journal	UK	Elsevier Ltd.	98	Q1
23	Transportation Research Record, 2007(1), 111–116.	Book Series	USA	US National Research Council	119	Q2
24	Human Factors, 49(2), 227–242.	Journal	USA	Sage Publications Inc.	117	Q1
25	Ergonomics in Design, 16(4), 11–15	Journal	USA	Sage Publications Inc.	21	Q4
26	Journal of Safety Research, 39(4), 403–411	Journal	UK	Elsevier Ltd.	85	Q1

27	Human Factors, 50(6), 864–878.	Journal	USA	Sage Publications Inc.	117	Q1
28	Human Factors, 50(4), 576–588.	Journal	USA	Sage Publications Inc.	117	Q1
29	Reviews of Human Factors and Ergonomics, 5(1), 82–113.	Book Series	USA	Sage Publications Inc.	17	Q4
30	The International Journal of Aviation Psychology, 20(3), 269–294.	Journal	USA	Taylor and Francis Ltd.	0	Q3
31	Safety Science, 48(10), 1445–1451.	Journal	The Nether-lands	Elsevier	111	Q1
32	International Journal of Applied Aviation Studies, 10(1), 117–130.	Journal	USA	Federal Aviation Administration Academy (US)	11	Q4
33	Human Factors, 52(3), 381–410.	Journal	USA	Sage Publications Inc.	117	Q1
34	Aerospace Medicine and Human Performance, 82(5), 543–549.	Journal	USA	Aerospace Medical Association	69	Q3
35	The International Journal of Aviation Psychology, 22(1), 1–17.	Journal	USA	Taylor and Francis Ltd.	0	Q3
36	Safety Science, 50(3), 472–477.	Journal	The Nether-lands	Elsevier	111	Q1
37	Transportation Research Record, 2300(1), 1–12.	Book Series	USA	US National Research Council	119	Q2
38	Journal of Cognitive Engineering and Decision Making, 7(2), 141–154.	Journal	USA	SAGE Publications Inc.	31	Q2
39	Human Factors, 55(2), 267–277.	Journal	USA	Sage Publications Inc.	117	Q1
40	Transportation Research Record, 2336(1), 105–116.	Book Series	USA	US National Research Council	119	Q2
41	Human Factors, 56(8), 1337–1363.	Journal	USA	Sage Publications Inc.	117	Q1
42	Human Factors, 56(4), 631–644.	Journal	USA	Sage Publications Inc.	117	Q1
43	International Journal of Industrial Ergonomics, 50, 73–96.	Journal	The Nether-lands	Elsevier	79	Q2

44	International Journal of Industrial Ergonomics, 46, 44–58.	Journal	The Netherlands	Elsevier	79	Q2
45	Transportation Research Record, 2471(1), 48–57.	Book Series	USA	US National Research Council	119	Q2
46	Ergonomics in Design, 23(4), 20–22.	Journal	USA	Sage Publications Inc.	21	Q4
47	Procedia Engineering, 128, 25–34.	Conferences and Proceedings	The Netherlands	Elsevier BV	74	n.a.
48	Human Factors, 58(6), 864–885.	Journal	USA	Sage Publications Inc.	117	Q1
49	Accident Analysis and Prevention, 86, 209–216.	Journal	UK	Elsevier Ltd.	152	Q1
50	Transportation Research Record, 2582(1), 61–71.	Journal	USA	US National Research Council	119	Q2
51	IFAC–PapersOnLine, 49(19), 66–71.	Journal	Austria	IFAC Secretariat	72	Q3
52	Journal of Cognitive Engineering and Decision Making, 10(4), 411–419.	Journal	USA	SAGE Publications Inc.	31	Q2
53	Aerospace Medicine and Human Performance, 88(5), 497–499.	Journal	USA	Aerospace Medical Association	69	Q3
54	Journal of Cognitive Engineering and Decision Making, 11(2), 166–183.	Journal	USA	SAGE Publications Inc.	31	Q2
55	Human Factors, 59(2), 204–228.	Journal	USA	Sage Publications Inc.	117	Q1
56	The International Journal of Aviation Psychology, 27(3–4), 121–136.	Journal	USA	Taylor and Francis Ltd.	0	Q3
57	Applied Ergonomics, 65, 200–208.	Journal	UK	Elsevier Ltd.	98	Q1
58	Transportation Research Record, 2672(23), 106–116.	Book Series	USA	US National Research Council	119	Q2
59	IEEE Access, 7, 25438–25451.	Journal	USA	Institute of Electrical and Electronics Engineers Inc.	127	Q1

60	Journal of Cognitive Engineering and Decision Making, 13(2), 81–101.	Journal	USA	SAGE Publications Inc..	31	Q2
61	Aerospace Medicine and Human Performance 91, no. 4 (2020): 318–325.	Journal	USA	Aerospace Medical Association	69	Q3
62	Human Factors, 62(5), 737–750.	Journal	USA	Sage Publications Inc.	117	Q1
63	Frontiers in Psychology, 11.	Journal	Switzerland	Frontiers Media S.A.	110	Q2
64	Transportation Research Procedia, 51, 271–282.	Conferences and Proceedings	The Netherlands	Elsevier BV	40	n.a.
65	Journal of Air Transport Management, 89, 101922.	Journal	UK	Elsevier Ltd.	75	Q1
66	Safety Science 130 (2020): 104892.	Journal	The Netherlands	Elsevier	111	Q1
67	Journal of Cognitive Engineering and Decision Making, 14(4), 263–287.	Journal	USA	SAGE Publications Inc.	31	Q2
68	Human Factors, 62(4), 553–564.	Journal	USA	Sage Publications Inc.	117	Q1
69	IEEE Transactions on Human–Machine Systems, 51(6), 632–640.	Journal	USA	IEEE Systems, Man, and Cybernetics Society	123	Q1
70	Journal of Safety Research, 76, 127–134.	Journal	UK	Elsevier Ltd.	85	Q1
71	Transportation Research Record, 03611981211051617.	Book Series	USA	US National Research Council	119	Q2
72	The 2021 Third International Conference on Big Data Engineering (pp. 144–149)	Conferences and Proceedings	USA	Association for Computing Machinery	n.a.	n.a.
73	International Journal of Industrial Ergonomics, 85, 103169.	Journal	The Netherlands	Elsevier	79	Q2
74	Applied Ergonomics, 100, 103642.	Journal	UK	Elsevier Ltd.	98	Q1

Appendix B. Most Cited Articles

Ref.	Title	Description	Methodology	Conclusions
[56]	Complacency and Bias in Human Use of Automation: An Attentional Integration	The paper reviews empirical studies on complacency and bias in human interaction with automated systems, providing an integrated theoretical model for their explanation, emphasizing the overlap between complacency and automation bias and the role of attention in both phenomena and discussing practical applications for mitigating complacency and bias in automated systems.	Studies on complacency and automation bias were analyzed concerning the cognitive processes involved.	- Automation complacency occurs in multitasking environments when manual tasks compete with the automated task for the operator's attention. - Automation bias leads to errors in decision-making when interacting with imperfect decision aids, including both omission and commission errors. - Complacency and automation bias are related phenomena stemming from overtrust in automated systems and involve attentional processes.
[57]	Human–Automation Interaction	The paper provides a comprehensive review of the history, current status, and future directions of human–automation interaction research, emphasizing the expansion of research beyond traditional domains and highlighting the impactful and exciting nature of this field, with an expectation for continued acceleration in the future.	The methodology involved a Scopus search using specific keywords related to automation, followed by a qualitative analysis of IJHCS papers to identify common themes per decade. The authors reviewed the contributions of IJHCS to the study of human–automation interaction and acknowledged the continuous expansion of this field into new domains and contexts.	The paper's main findings include a review of the history, current status, and future directions of human–automation interaction research, highlighting the increased use of automated systems in various settings.
[46]	Team Training in the Skies: Does Crew Resource Management (CRM) Training Work?	The paper discusses the effectiveness of CRM training in aviation based on participant reactions, learning, and behavior but notes a lack of clear evidence on its impact on safety, highlighting the importance of collecting information from multiple levels of evaluation. It acknowledges the existence of evidence supporting the effectiveness of CRM training despite the lack of clear conclusions. It emphasizes the need for more systematic studies to establish a vital link between CRM training and safety outcomes.	The methodology used in the study involved evaluating CRM training programs using Kirkpatrick's typology with four levels: reactions, learning, behavior, and results. 41% of the identified studies collected information at multiple levels, with an emphasis on the importance of comprehensive evaluations.	- CRM training generally produces positive reactions, enhances learning, and promotes desired behavioral changes. - CRM training programs effectively produce positive participant reactions, learning, and application of learned behavior. - Multilevel evaluations in the aviation community are becoming more common, but there is a need for evaluation to be systematically accepted as a cost of business.

[58]	Human Error and Commercial Aviation Accidents: An Analysis Using the Human Factors Analysis and Classification System	The paper discusses the analysis of commercial aviation accidents using HFACS, emphasizing the role of human error and the need for interventions to improve aviation safety.	The methodology involved analyzing data from 1020 commercial aviation accidents over 13 years using the HFACS framework, with six trained pilot-raters independently classifying human causal factors identified by the NTSB. Inter-rater agreement was high at over 85%.	The study focused on the predominance of aircrew and environmental factors in commercial aviation accidents, with skill-based errors being the most prevalent form of aircrew error.
[59]	Expertise Differences in Attentional Strategies Related to Pilot Decision Making.	The paper discusses how expert pilots outperformed novices in decision-making speed and accuracy, showed better attentional strategies by attending to relevant cues during failures, and responded more quickly to problems, significantly when cues were correlated.	The methodology involved 14 expert and 14 novice pilots flying 16 brief simulated flights each in a simulator. Eye-tracking data was recorded within 26 areas of interest, and experienced flight instructors created and validated scenarios.	- Expert pilots outperformed novices in decision-making speed and accuracy. - Both expert and novice pilots benefited from high diagnosticity cues. - Experts performed better with correlated cues, while novices performed worse in this condition.
[60]	Failure to Detect Critical Auditory Alerts in the Cockpit: Evidence for Inattentional Deafness	The study tested pilots' vulnerability to unintentional deafness in a simulated cockpit under different weather conditions and found that pre-exposure to the auditory alarm reduced the likelihood of accidental deafness.	The methodology involved general aviation pilots performing landings in a flight simulator under different scenarios with varying cognitive demands at the critical moment of the audio alarm. Measures included subjective self-reports and objective measurements to evaluate the impact of wind shear on workload and stress and its effect on detecting the audio alarm.	Pre-exposure to the auditory alarm in a no-wind shear scenario reduced the likelihood of unintentional deafness in a subsequent wind shear scenario, highlighting the potential impact of cognitive limitations on pilot behavior.
[34]	Human Error in ATC System Operations	The research analyzes human factors in commercial aviation accidents, focusing on aircrew, environmental, supervisory, and organizational factors using the HFACS. Findings show that most accident causal factors are linked to aircrew and the environment, with fewer related to supervision and organization. The study underscores the need to address human error in aviation accidents for improved safety measures, recommending data-driven interventions to enhance commercial aviation safety.	Several ATC-related aircraft accidents are summarized to illustrate the controller's changing role and how the controller interacts with pilots, other controllers, and the work environment.	- Pilots who encountered deteriorating weather earlier tended to fly longer before diverting, with more optimistic weather estimates than those who experienced it later. - Flight experience influenced pilots' decisions, with more experienced pilots tending to divert sooner.

[47]	The Role of Situation Assessment and Flight Experience in Pilots' Decisions to Continue Visual Flight Rules Flight into Adverse Weather	The paper discusses the safety hazard of VFR flight into IMC in general aviation, examines pilots' decisions during a simulation, suggests poor situation assessment and experience contribute to VFR flight into IMC, and investigates how weather location affects pilots' decisions.	The methodology involved a dynamic simulation of a cross-country flight with private pilots from central Illinois. Participants provided demographic and flight experience information, completed pre- and post-experimental questionnaires, and assessed weather conditions during the simulation.	- Pilots who encountered deteriorating weather earlier tended to fly longer before diverting, with more optimistic weather estimates than those who experienced it later. - Flight experience influenced pilots' decisions, with more experienced pilots tending to divert sooner.
[37]	An Investigation of the Effectiveness of Pilot Judgment Training	The paper discusses pilot decisional errors, which have been a significant factor in aviation accidents. Pilot judgment, however, traditionally has been viewed as an intrinsic quality or a by-product of flying experience. Only recently has it been examined as a potential flight training requirement.	In this study, the judgment skills of Canadian civilian air cadets who received judgment training both in the classroom and in flight while earning a private pilot license were compared with those of a control group of cadets who received conventional training.	The results indicate that those subjects who had received judgment training averaged fewer decisional errors than their counterparts who had received the standard training only. These results suggest that pilot judgment can be improved with training.
[39]	Development and Validation of the Safety Locus of Control Scale	The paper discusses the development and validation of the Safety Locus of Control Scale to predict employees' accidents and injuries based on their internal or external safety locus of control beliefs, its effectiveness in differentiating between groups with varying accident histories, and the assessment of any adverse impact on legally protected minority groups.	The methodology involved developing the Safety Locus of Control Scale with 17 face-valid items, using a Likert-type scale, weighting item scores based on a median split and converting raw scores to stanine scores for analysis.	Differentiation in the safety-related locus of control beliefs based on accident history, the significant difference in locus of control beliefs between high-risk and low-risk groups, and no adverse impact for sex with a suggested similar relationship for race.
[41]	Using the Subjective Workload Dominance (SWORD) Technique for Projective Workload Assessment	The paper evaluates the subjective workload dominance (SWORD) technique as a projective workload tool, showing positive correlations between projective and retrospective workload ratings and emphasizing the need for subject matter experts to make accurate predictions.	The methodology involved predicting workload for HUD formats using the SWORD technique, correlating predictions with retrospective ratings, and conducting Pro-SWORD evaluations with SMEs and students. Different groups were assigned for simulator evaluation: SWORD, SME Pro-SWORD, and Student Pro-SWORD.	- The SWORD technique is a valuable projective tool when subject matter experts are involved - Expert projective ratings correlated well with retrospective ratings from operational F-16 pilots - The SWORD technique can aid in early system design by incorporating expert opinions effectively

[61]	Pilot Maneuver Choice and Workload in Free Flight	The paper discusses two experiments that examined pilots' maneuver choices and visual workload in a free-flight simulation. Experiment 1 involves a cockpit display of traffic information, and Experiment 2 focuses on following ATC instructions.	The methodology involved conducting two experiments with pilots using a high-fidelity flight simulator to compare maneuver choices and visual workload with and without a cockpit display of traffic information (CDTI). Experiment 1 included the CDTI, while Experiment 2 did not, and pilots followed ATC instructions. The study analyzed pilots' behavior and visual attention allocation in free-flight scenarios.	The study's main findings include pilots' preference for vertical over lateral avoidance maneuvers, a tendency to climb rather than descend, and factors like safety, efficiency, mental effort, and prior habits in maneuver choices.
[36]	Pilot Judgment: Training and Evaluation	The paper emphasizes the importance of using the Student Manual, scenarios, and the role of the flight instructor in teaching judgment training to pilots, highlighting the need for instructors to actively engage with students to help them develop good judgment and flying practices.	The methodology involves integrating judgment training concepts with real-life flight situations, conducting concept lessons to practice specific skills, and guiding students in making observations and decisions during the flight.	- The Student Manual contains the majority of the judgment training course material. - The training is aimed at helping pilots improve their judgment in various flight situations. - The attitude and approach of flight instructors can significantly impact students' judgment training.
[49]	Weatherwise: Evaluation of a Cue-Based Training Approach for the Recognition of Deteriorating Weather Conditions during Flight	The paper discusses the issue of fatalities in the general aviation industry due to continued visual flight into IMC. The challenges pilots face in such situations and the evaluation of a cue-based training program for pilots to recognize and respond to deteriorating weather conditions during flight.	The methodology involved recruiting 66 licensed private pilots from Australia, aged 19 to 47 years, with varying levels of flying experience, and randomly assigning them to either a cue recognition group or a control group.	The computer-based training program improved pilots' recognition of critical weather cues and decision-making during simulated inflight scenarios.
[62]	Risk Tolerance and Pilot Involvement in Hazardous Events and Flight into Adverse Weather	The paper explores the role of risk tolerance in pilot decision-making, the influence of opportunity and threat on risk tolerance, and the relationship between risk tolerance and involvement in hazardous events, using a policy-capturing methodology to measure risk tolerance in GA pilots.	The methodology involved presenting pilots with flight scenarios varying in opportunity and threat levels, rating the likelihood of undertaking each flight, and using policy-capturing methods to measure risk tolerance in GA pilots.	- Pilots influenced by opportunities were involved in more hazardous incidents. - Pilots who continued flying into adverse weather were less risk averse. - Risk tolerance can predict potential accident involvement among general aviation pilots.

[63]	The Role of Working Memory in Levels of Situation Awareness	The paper explores the relationship between working memory and levels of situation awareness, showing that while working memory was unrelated to Level 1 SA, it was related to Level 3 SA and performance in prediction trials. The findings highlight the significance of working memory in cognitive processes related to situation awareness and task performance.	The methodology involved a factor analytic approach to working memory, calculation of per-engine error, testing for mediation between WM and performance, and examining correlations between WM and different aspects of situation awareness.	- WM was unrelated to Level 1 SA but related to Level 3 SA, strengthening with task experience. - WM negatively correlated with time to view fire engines and idle time in Level 3 SA. - Higher WM positively influenced SA and performance.
[64]	Aviation Automation: General Perspectives and Specific Guidance for the Design of Modes and Alerts	This review notes the recent insights into aviation human–automation interaction, starting with a quick tour of the modern flight deck to illustrate the current state of the art in applying automation in safety-critical systems.	The review then contrasts three prevalent perspectives on applying automation: those that focus on the technology itself, automation within the operating environment, and automation as a team member.	The reviewed notes on considerations regarding the certification, testing, and evaluation of automation (and human–automation interaction) in the safety-critical domain of aviation.
[35]	Cockpit Displayed Traffic Information and Distributed Management in Air Traffic Control	The technical feasibility of graphically displaying information such as surrounding aircraft and navigation routes in the cockpit on a cathode ray tube has been suggested as a viable method for improving the safety, orderliness, and expeditiousness of the air traffic control system by distributing some of its management to the pilots equipped with this cockpit displayed traffic and navigation information (CDTI).	Several years of experimental study of this concept, using a three-cab simulator facility at NASA-Ames, have produced consistent findings relating to system performance, pilot and controller workloads, and opinions. These findings generally agree with those from other studies.	On balance, distributed management offers significant advantages for air traffic control.
[26]	Evaluation of Computer-Based Situation Awareness Training for General Aviation Pilots	The paper evaluates the effectiveness of computer-based training modules for improving situation awareness in general aviation pilots, emphasizing the importance of maintaining high levels of situation awareness for pilot decision-making and safety in the airspace system.	The modules targeted basic skills training for low-time pilots (checklist completion, air traffic control comprehension, psychomotor skills) as well as training on higher order cognitive skills (attention sharing, contingency planning) and intensive preflight planning.	The training modules successfully improved fundamental skills, including checklist knowledge, reaction time in responding to ATC clearances, and psychomotor tracking. The attention-sharing training module enhanced participants' ability to perform multiple tasks concurrently, while the preflight and contingency planning training modules improved planning performance.

[65]	Effects of Air Traffic Congestion Delays under Several Flow-Management Policies	Air traffic delays occur when demand for airports or airspace exceeds available capacity. Consequently, increasing capacity or modifying air traffic demand can lessen these delay effects.	A tactical optimization model is highly complex because of the uncertainty in airport capacity forecasts, which primarily depend on weather.	A practical implementation of a tactical optimization model must make approximations so that a solution may be computed quickly and be of good quality. A helpful model framework for the congestion-delay problem is given; this model framework is a generalization of several other flow-management models.
[66]	Display Dimensionality and Conflict Geometry Effects on Maneuver Preferences for Resolving In-Flight Conflicts	The paper explores the effects of display dimensionality, conflict geometry, and time pressure on pilot maneuvering preferences for resolving conflicts in en-route airspace, emphasizing the importance of understanding these influences for future airspace design and automation.	The methodology involved pilots resolving conflicts using CDTIs with different display dimensionality levels, including 2D and 3D views. The average age of participants was 22 years, with an average of 400 flight hours. Two 3D display formats were used to reduce vertical representation ambiguity, and a strategic route replanning tool (RAT) was utilized for pilots to create and implement deviations from the flight path.	Pilots consistently preferred vertical over lateral maneuvers in low workload conditions and climbs over descents for level-flight conflicts. With increasing workload, 3D perspective displays increased the preference for lateral over vertical maneuvers. Time pressure led to increased vertical maneuvers, particularly with the 3D perspective displays.
[38]	Flight-Skill Decay and Recurrent Training	The paper discusses the importance of recurrent training in preventing flight-skill decay, mainly focusing on cognitive training and transferring skills to the aircraft.	The methodology involves describing the importance of recurrent training methods, emphasizing cognitive training, and discussing the advantages of recurrent cognitive training.	The main findings emphasize the importance of recurrent training, particularly cognitive training, in preventing the decay of flight skills and improving operational safety.
[67]	The Pilot Sees Pilot Do: Examining the Predictors of Pilots' Risk Management Behavior.	The paper examines how risk perception and attitude can predict pilots' risky flight behavior, with implications for pilot selection and training based on risk management behavior.	The methodology used scales to measure risk perception, attitude, and demographic variables to predict pilots' willingness to engage in risky flight behavior.	The main findings highlight the importance of risk perception, age, and self-confidence in predicting pilots' risk management behavior.

[31]	The Automation-by-Expertise-by-Training Interaction: Why Automation-Related Accidents Continue to Occur in Sociotechnical Systems	The paper introduces the automation-by-expertise-by-training interaction in automated systems, discusses its impact on operator performance, emphasizes the need for research in this area, and recommends establishing automation-related metrics in the design process to reduce automation-related errors.	The methodology involves reviewing accident investigation reports, regulator studies, and literature on human-computer interaction, expertise, and training to discuss the impact of neglecting the automation interaction, expertise level, and training on operators committing identical automation-related errors. The author suggests further research in this area, potentially utilizing observational and ethnographic research.	The paper introduces the automation-by-expertise-by-training interaction in automated systems, emphasizing the need to align automation with operator expertise levels and training programs to minimize automation-related errors.
[68]	Graphical Weather Information System Evaluation: Usability, Perceived Utility, and Preferences from General Aviation Pilots	The paper discusses the usability and perceived utility of a prototype Graphical Weather Information System for GA pilots, highlighting positive feedback and suggestions for improvements to enhance weather situation awareness and decision-making.	The methodology involved evaluating a prototype GWIS by 12 GA pilots after using the system in flights toward convective weather, following a within-subjects experimental design with specific participant selection criteria. The study aimed to assess the usability of the GWIS in the context of flight near convective weather and provide design implications based on the results.	The study's main findings indicate that participants had a positive overall impression of the GWIS, with a high percentage indicating its importance for GA operations. Additionally, pilots in commercial flight deck environments also embraced the technology enthusiastically. The functionality of the GWIS was found to be reasonably adequate, with participants showing enthusiasm for having graphical NEXRAD weather in flight.
[69]	Characteristics of Pilots Who Report Deliberate Versus Inadvertent Visual Flight into Instrument Meteorological Conditions	The paper examines the characteristics of pilots who report deliberate versus inadvertent visual flight into instrument meteorological conditions, emphasizing the need to address the issue considering experience and individual differences in risk tolerance.	The methodology involved data collection through a demographic survey, a risk perception test, and questions about pilots' weather-related criteria and hazardous event involvement. Pilots were asked about the deliberate or inadvertent nature of their entry into IMC and the specific reasons for their behavior. An analysis compared pilots with and without an instrument rating regarding their likelihood of reporting deliberate entry and the reasons provided.	- Pilots who deliberately entered instrument conditions had prior experience, higher risk tolerance, lower anxiety, and perceived lower risks compared to those who entered inadvertently. - Continued efforts are needed to prevent visual pilots from operating in conditions leading to loss of reference to the horizon. - Some visual pilots understand the risks but still proceed into conditions where they lose reference to the horizon.

[53]	Portable Weather Applications for General Aviation Pilots	The study found that portable weather applications improved pilot weather situation awareness and cognitive engagement. However, both groups still flew closer to hazardous weather than recommended, indicating a need for optimizing weather display mechanisms and pilot training.	The methodology involved a study with 70 general aviation pilots randomly assigned to experimental and control groups. Pilots flew a simulated single-engine GA aircraft under visual meteorological conditions, with measures recorded for weather situation awareness, decision-making, cognitive engagement, and distance from hazardous weather. The experimental group used a handheld weather application similar to commercial products.	- The portable weather application increased the experimental group's weather situation awareness (WSA), leading to more significant route deviations and greater distances from hazardous weather than the control group. - Both groups flew closer to hazardous weather cells than recommended, suggesting that increased WSA did not automatically improve flight behavior. - The study supports using portable weather displays without compromising pilot performance but emphasizes the importance of pilot training and optimizing weather display mechanisms.
[70]	Using STPA in the Evaluation of Fighter Pilots Training Programs	The paper discusses using the STPA method to evaluate fighter pilots' training programs, identifies inadequacies in the current program, and provides recommendations for improvement in military flight training and risk management.	The methodology used in the study is the System-Theoretic Process Analysis (STPA) method, which was applied to evaluate fighter pilot training programs by considering safety constraints, control actions, and feedback mechanisms documented in fighter aircraft's documentation and the Standard Operating Procedures (SOPs) of a South European Air Force (SEAF). Assumptions were made to simplify the study, and the researchers utilized the A-STPA software v.1 to apply the STPA technique.	The study identified inadequacies in the flight training program, particularly in addressing multiple safety constraints and human performance deterioration. Recommendations were made to amend the fighter pilots' training program and conduct further research on aircraft–pilot interaction in multiple safety constraint violation scenarios.
[71]	Situation Awareness Training for General Aviation Pilots using Eye Tracking	The paper introduces a new training design for general aviation pilots to improve situation awareness through theoretical information and practical exercises, including using biofeedback with eye-tracking devices.	The methodology involved an extensive literature review, interviews with flight instructors, a needs assessment survey with general aviation pilots, and a training evaluation on simulation flights with licensed pilots.	The paper introduces a simulation-based training design for general aviation pilots to improve situation awareness and scanning skills, involving practical exercises, biofeedback, and theoretical information.

[72]	Accident-precipitating Factors for Crashes in Turbine-Powered General Aviation Aircraft	The paper aims to identify accident-precipitating factors and changes in accident rates for turbine-powered aircraft under 14CFR Part 91, and is the first to identify novel precursive factors for accidents in this category, emphasizing areas for training and prevention.	The methodology involved querying the NTSB Access database for accidents in turbine-powered airplanes, developing an accident-precipitating factor taxonomy, and conducting statistical analyses using logistic regression, contingency tables, and a generalized linear model with Poisson distribution.	- The most frequent accident-precipitating factors leading to fatal accidents in turbine aircraft operating under 14CFR Part 91 were related to not following checklists and flight manuals, inadequate preflight planning, and violations of Federal Aviation Regulations/Aeronautical Information Manual (OR 2.34, OR 2.22, OR 2.59 respectively).

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