Digital Preflight Planning in General Aviation: The Role of Pilot Self-Efficacy and Information Quality

Nuno Moura Lopes* [0000-0003-4269-8892]
nuno.lopes@novaims.unl.pt,
Manuela Aparício [0000-0003-4261-0344]
manuela.aparicio@novaims.unl.pt,
Fátima Trindade Neves [0000-0003-1778-9717]
fneves@novaims.unl.pt

NOVA Information Management School (NOVA IMS), Campus de Campolide, Universidade Nova de Lisboa, 1070-312 Lisboa, Portugal

*Corresponding author

Lopes, N. M., Aparicio, M., & Neves, F. T. (2025). Digital Preflight Planning in General Aviation: The Role of Pilot Self-Efficacy and Information Quality. Journal of Aerospace Information Systems. *https://doi.org/10.2514/1.I011633*

Digital Preflight Planning in General Aviation: The Role of Pilot Self-Efficacy and Information Quality

Nuno Moura Lopes[*‡], Manuela Aparicio[*], and Fátima Trindade Neves[*]

[*] NOVA Information Management School (NOVA IMS), Campus de Campolide
1070-312 Lisboa, Portugal, Lisbon Portugal
nuno.lopes@novaims.unl.pt, manuela.aparicio@novaims.unl.pt, fneves@novaims.unl.pt

Abstract

Preflight planning is a critical phase in general aviation (GA), increasingly supported by digital tools. However, limited research has examined how pilots' self-efficacy and perceptions of information and technology quality affect preflight planning effectiveness. This study explores the relationships among self-efficacy, information quality, technology characteristics, and perceived preflight planning effectiveness. A survey of 135 GA pilots was conducted, and data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings reveal that traditional experience indicators,flight hours, years licensed, and flying frequency, do not significantly predict self-efficacy. Technology characteristics significantly influence self-efficacy, while information quality significantly predicts digital tool use . Contrary to expectations, self-efficacy does not significantly influence perceived planning effectiveness, although digital tool use has a marginal effect. These results emphasize the importance of high-quality, usable information over traditional experience measures or general confidence in predicting planning success. Implications for pilot training and digital tool design include shifting focus toward user-centered systems and structured support for preflight decision-making.

Keywords: Self-efficacy; General aviation; Information systems; Digital tools

1. Introduction

General Aviation (GA) preflight planning is a critical process that significantly influences safety and operational outcomes. A well-executed preflight briefing allows pilots to assess weather conditions, review NOTAMs, evaluate performance limitations, and plan for potential contingencies, reducing the risk of incidents and accidents [1, 2]. Yet, despite its importance, preflight planning is a complex and highly variable activity that depends not only on external factors such as available digital tools and data quality but also on internal, pilot-centric factors such as knowledge, motivation, and self-efficacy [3, 4].

Self-efficacy, an individual's belief in their ability to complete a specific task, has long been recognised as a central determinant of performance across domains, including aviation [3, 5]. In the context of GA, self-efficacy influences how pilots approach preflight planning tasks, interpret available data, and integrate digital tools into their workflow [4]. Unlike traditional experience metrics such as total flight hours or years holding a pilot's license, self-efficacy captures the role of a pilot's perception of their ability to utilise available resources and tools effectively [6]. This consideration is increasingly relevant

---

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

as GA transitions towards digital platforms and mobile applications that centralise and streamline preflight planning [7].

Modern digital preflight planning tools, such as Electronic Flight Bags (EFBs), provide access to dynamic, high-quality information, making data quality and technology characteristics pivotal for their effective use [8, 9]. The quality of information, including its accuracy, timeliness, and completeness, has been identified as a strong determinant of technology usage and user satisfaction across information-centric environments [9]. In aviation, meteorological, navigational, and NOTAM data quality can directly impact a pilot's ability to anticipate, comprehend, and plan for complex operational scenarios [10]. However, prior studies have yielded mixed findings regarding traditional experience indicators, such as total flight hours and years with a pilot's license, shaping self-efficacy within digital preflight planning contexts [4]. This suggests task-specific confidence may be more significant than accumulated experience in determining pilots' perceptions of their preflight planning effectiveness.

Moreover, the literature highlights the increasing separation between traditional experience and digital tool proficiency measures. Studies in aviation psychology and technology acceptance have argued that general experience does not necessarily guarantee proficiency with digital platforms, and that self-efficacy tailored to specific digital preflight tasks may be a more accurate predictor of practical tool usage [4, 11]. In this regard, GA pilots often operate with varying levels of comfort and competence when using digital planning platforms, regardless of their flight experience or years with a pilot's license [10].

Against this backdrop, this paper aims to investigate the role of self-efficacy and digital planning tools' quality, information quality, system quality, and technology characteristics in shaping GA pilots' perceptions of their preflight planning effectiveness. By focusing on the psychological and technological antecedents of preflight planning in GA, this study provides new insights for aviation training, digital tool design, and operational risk management. It advances the theoretical understanding of self-efficacy and technology use in aviation while addressing a pressing practical concern for GA safety.

2. Literature background

Self-efficacy, an individual's belief in their ability to perform specific tasks, has emerged as a pivotal construct in understanding behaviour and performance across highly technical domains, including General Aviation (GA) [3]. Initially developed by [3], Self-Efficacy theory posits that individuals' beliefs about their capabilities to perform specific tasks significantly influence their performance, motivation, and persistence in facing challenges [12]. According to Bandura's theoretical framework [3], self-efficacy beliefs are developed through four primary sources: mastery experiences (direct performance accomplishments), vicarious experiences (observational learning), verbal persuasion (social influence), and physiological and emotional states. In aviation, self-efficacy encompasses pilots' confidence in operating aircraft safely, making appropriate decisions under pressure, and effectively managing various flight scenarios [13]. The construct has been operationalised in aviation research through measures of general pilot confidence, specific skill-related efficacy beliefs, and situation-specific confidence assessments [14-16]. In aviation environments, where pilots must integrate information, interpret uncertainty, and make rapid decisions, self-efficacy influences the quality and

---

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

consistency of preflight planning [4]. Whereas traditional metrics such as total flight hours or years with a pilot’s license have long been used to approximate pilot proficiency, recent studies have shown that such general experience indicators have limited predictive value for actual performance when using digital platforms [17]. In this context, self-efficacy is a more precise, task-specific measure that captures a pilot’s ability and willingness to effectively utilise available digital tools and data [15].

Recent research has demonstrated the critical role of self-efficacy in pilots' ability to handle special situations and emergencies. A comprehensive study by [15] examined the influence of self-efficacy on male military pilots' capability to handle special situations using a moderated mediation model. The study, involving 251 pilots assessed using standardized scales, found that pilots with high self-efficacy demonstrated improved resilience, enhancing their capability to handle special situations. Notably, the research revealed that the influence of self-efficacy on special situation handling through resilience was moderated by perseverance, suggesting that individual differences in persistence amplify the benefits of high self-efficacy beliefs.

Information quality is central to GA preflight planning, as pilots must access, assess, and synthesise meteorological data, NOTAMs, airspace restrictions, and other operational inputs to build a safe and efficient flight plan [18, 19]. Studies have consistently found that available data quality, timeliness, and completeness are critical for supporting effective preflight planning and risk mitigation [20]. Yet, utilising high-quality information depends critically on the pilot’s self-efficacy [13]. Pilots with higher self-efficacy are more adept at extracting actionable insights from complex data, interpreting ambiguous or rapidly updating information, and aligning preflight planning with operational constraints [15]. Conversely, low self-efficacy can lead to under-utilisation of available data and digital platforms, regardless of the quality of the information presented [21].

System characteristics, reliability, responsiveness, and user-centred design have long been emphasised in the literature as foundational elements for digital preflight planning platforms, such as Electronic Flight Bags (EFBs) [7, 8]. However, recent research highlights that the effectiveness of such platforms is mediated more by self-efficacy than by their design characteristics alone [15]. Even platforms that excel in information quality and user experience may fail to realise their potential benefits when pilots with low self-efficacy use them. In contrast, pilots with higher self-efficacy tend to adapt more readily to new digital platforms, making better use of available features and extracting higher value from advanced information services [22]. This finding shifts the focus from traditional design-centric metrics towards a more user-centric, self-efficacy-oriented approach.

Technology use has evolved from a static operational requirement to a dynamic component of GA preflight planning [10]. The role of digital platforms in supporting preflight planning has been extensively examined across aviation and other information-intensive domains, highlighting their contribution to decision quality, error mitigation, and overall safety [20]. Yet, the successful utilisation of these platforms depends not only on the characteristics of the technology itself but also on the pilot’s belief in their ability to apply the technology effectively within their preflight workflow [23]. Studies have confirmed that self-efficacy is a pivotal mediator between access to high-quality digital information and its successful translation into actionable preflight

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

planning decisions [4]. This role is particularly critical in GA, where pilots must balance evolving meteorological conditions, airspace constraints, and equipment limitations with the practical demands of flight planning [17, 24].

This evidence suggests that traditional experience indicators, such as total flight hours or years of licensure, have limited predictive value for preflight planning effectiveness in GA. Instead, self-efficacy emerges as the central determinant of how GA pilots perceive and utilise digital tools and information platforms. By focusing on self-efficacy, researchers and practitioners can better understand the interplay between pilot characteristics, information quality, and digital tool design, providing actionable insights for pilot training, digital platform design, and safety interventions. In this way, a self-efficacy-driven approach to preflight planning can advance both theoretical understanding and practical application in GA, aligning technological advances with pilots' psychological and behavioural needs [4, 15, 22].

3. Research model and hypothesis

This study explores the influence of general aviation (GA) pilots’ self-efficacy and perceptions of digital platform characteristics on their use of technology and perceived effectiveness in preflight planning. The research model is grounded in social cognitive theory [3] and informed by established models of information systems success [9]. Drawing on these established theories, we formulate the following hypotheses. Figure 1 presents our hypothesized associations among the study constructs. Arrows indicate the expected direction of each relationship (H1–H10), with solid lines for focal paths and dashed lines for controls.

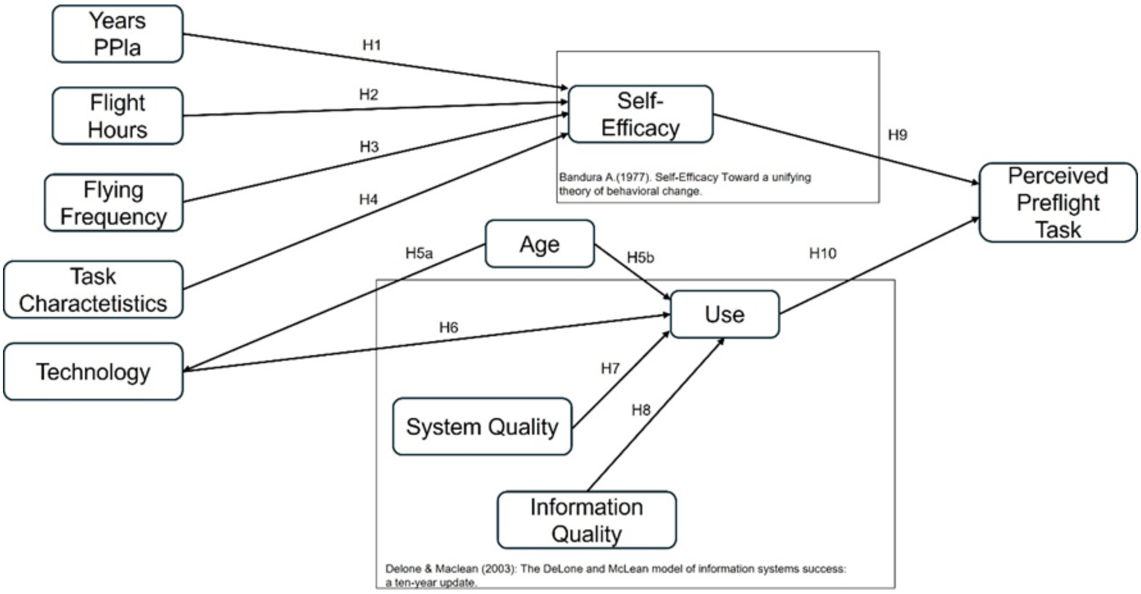

Figure 1. Research model: hypothesized associations among constructs.

Notes: YL = Years Licensed; FH = Flight Hours; FF = Flying Frequency; AGE = Age; TC = Task Characteristics; TEC = Technology Characteristics; SQ = System Quality; IQ = Information Quality; SE = Self-Efficacy; USE = Use of Digital Preflight Tools; PP = Perceived Effectiveness of Preflight Performance. Arrows indicate hypothesized associations (H1–H10).

---

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

According to, [3], self-efficacy reflects an individual's belief in their ability to perform tasks. This translates to a pilot's confidence in flight planning and decision-making in aviation. We conceptualize pilot experience as time since private pilot certification (years holding a PPL), which captures prolonged exposure to preflight planning routines and regulatory practices. Accordingly, we hypothesize:

H1: Years licensed (YL) has a positive relationship with preflight self-efficacy (SE).

Total flight hours are a commonly used proxy for operational expertise in aviation research [17]. Repeated experience contributes to refining skills and reinforces confidence, a key component of self-efficacy [3, 25]. Therefore, pilots with more flight hours are expected to demonstrate higher self-efficacy in preflight contexts.

H2: Flight hours has a positive relationship on Self-efficacy.

Flying frequency reflects a pilot's recent engagement with flight tasks. [26] found frequent flying is associated with higher proficiency, enhancing a pilot's self-confidence. According to [3], mastery experiences are a central source of self-efficacy, suggesting that flying more often reinforces this belief. Hence, we hypothesise that:

H3: Flying frequency has a positive relationship with Self-efficacy.

Task characteristics, such as complexity, clarity, and perceived controllability, have impacted self-efficacy [27, 28]. In aviation, structured preflight tasks like weather analysis and NOTAM interpretation can enhance a pilot's sense of competence and control, improving self-efficacy [29]. Hence, we hypothesise that:

H4: Task characteristics in preflight planning performance has a positive relationship with self-efficacy.

Age can influence cognitive flexibility and attitudes toward technology use. Older adults often report more difficulty adopting digital tools due to lower confidence, increased anxiety, or unfamiliarity [30, 31]. This may translate into lower usage and negative perceptions of digital tool features in aviation. Therefore, we hypothesize that:

H5a: Age has a positive relationship with use.

Diffusion and acceptance research consistently links age to lower adoption and use of new technologies, via both direct and indirect pathways. Directly, older users are less likely to incorporate new digital tools into routine practice due to habit strength, switching costs, and lower hedonic/novelty motives [32, 33]. Indirectly, age tends to be associated with less favorable technology perceptions (see H5a) and lower technology-specific self-efficacy, which in turn are associated with lower usage. In professional domains, training recency and exposure opportunities also differ by age cohort, further reducing day-to-day engagement with newer tools. Taken together, the literature supports a correlational expectation that higher age is associated with lower use of digital preflight tools (USE). Therefore we hypothesize that:

H5b: Age has a positive relationship with technology.

---

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

Technology characteristics, including perceived usefulness, reliability, and ease of use, are essential determinants of system adoption [11, 34]. Core IS theories consistently argue that users engage more with technologies they perceive as useful, reliable, and easy to use [35]. In the Technology Acceptance Model tradition, perceptions of usefulness/ease of use are primary antecedents of system usage, establishing the expectation that more favorable technology characteristics are associated with greater use [33]. Building on this, UTAUT integrates effort and performance expectancies and shows that favorable beliefs about a technology's attributes are associated with stronger usage behavior across contexts [36]. In aviation, tools that are perceived to align well with the user's needs and task demands are more likely to be used regularly and effectively [8, 10]. In this way, we hypothesise that:

H6: Technology characteristics has a positive relationship with use.

In the DeLone & McLean IS Success model, System Quality is a foundational antecedent of Use: systems perceived as reliable, available, easy to use, and responsive are more likely to be used. Empirical validations and extensions of this framework report the same association from SQ to use [9]. Aviation-adjacent evidence underscores this mechanism: electronic flight bag and planning tools perceived as dependable and usable see higher operational engagement [8]. System quality, referring to the usability, accessibility, and performance of digital platforms, has been linked to increased system use in aviation and IS literature [9, 37]. A reliable and easy-to-use planning tool is expected to encourage pilot engagement. Therefore, we draw the hypothesis that:

H7: System quality has a positive relationship with use.

In the DeLone & McLean IS Success model, Information Quality is a primary antecedent of Use: when users perceive information as accurate, complete, relevant, and timely, they are more likely to engage with the system. Empirical validations and extensions of this framework report the same IQ→Use association [9, 38] .

Information quality is critical in aviation, where planning decisions depend on timely, accurate, and relevant data. Prior research has shown that high-quality information improves trust in digital tools and increases usage [39, 40]. Thus, this study hypothesises that:

H8: Information quality has a positive relationship with use.

Research has shown that effective use of digital planning tools can enhance pilots' perceived task performance and planning confidence, particularly when information quality is high and system usability aligns with user expectations [15, 20]. In operational and training contexts, electronic flight bag (EFB) based workflows are associated with faster information access and lower workload, which support better preflight preparation and higher perceived effectiveness [8]. In general aviation weather decision-making, interface quality and timely, accurate information improve the quality and timeliness of pilots' judgments, reinforcing the link between tool engagement and perceived planning effectiveness [41]. Pilots who engage with these technologies during preflight are better positioned to identify potential hazards, evaluate route alternatives, and prepare for contingencies, contributing to a stronger sense of task completion and readiness [7].

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

Therefore, it is hypothesised that increased reliance on technological tools will positively affect pilots' perceived effectiveness in accomplishing preflight planning tasks.

H9: Use of technological tools has a positive relationship with perceived effectiveness of preflight performance.

Pilots with higher self-efficacy demonstrate greater confidence in navigating preflight procedures, managing digital tools, and interpreting relevant information [42]. This psychological resource enables them to perceive task demands as manageable, enhancing performance perceptions even under uncertainty [22]. Moreover, evidence suggests that self-efficacy mediates the relationship between work engagement and error reduction in aviation contexts, reinforcing its role as a key predictor of performance-related outcomes [4]. Therefore, self-efficacy is hypothesised to positively influence general aviation pilots' perceptions of their preflight planning effectiveness.

H10: Self-efficacy has a positive relationship with perceived effectiveness of preflight performance.

4. Methodological approach

4.1 Participants

The study sample consisted of 135 general aviation (GA) pilots recruited via social media groups, online aviation forums, and pilot associations operating primarily in Europe. To be eligible, participants were required to hold a valid private pilot license and have experience using digital tools for preflight planning. The average age was 50 years (SD = 15), and participants had an average of 3712 flight hours (34 to 22000). Demographic and background information, including total flight experience, years licensed, and flying frequency, was collected as control variables. Table 1 presents the sample attributes.

Table 1: Participant demographic data.

	Mean	Standard Deviation	Median	Minimum	Maximum
Age	49.70	14.74	-	20.00	76.00
Total Hours	4005.47	5983.82	14000	34.00	22000.00
Years Licensed	19.55	16.95	-	1.00	80.00
Flying frequency	2.30	0.88	-	1.00	6.00

4.2 Procedure

Data were collected through an online survey administered via Qualtrics. Participants were first informed of the study's purpose, assured of confidentiality, and asked to provide informed consent. Upon agreeing to participate, respondents completed the survey, which included items measuring the study constructs, demographic questions, and experience-related variables. Completion took approximately 10 to 12 minutes. The study followed ethical guidelines and received approval from the corresponding institutional review board.

4.3 Measures

All constructs were measured using multiple-item scales adapted from validated instruments in aviation psychology and information systems. Items were rated on a 5-point Likert scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). Table 2 presents the model contructs.

Table 2: Model constructs.

Construct	Code	Construct definition	Adapted from
System Quality	SQ	The Quality of the System is shown by the capacity it has in its processing tasks and whether or not it is adequate for the intended response. System Quality is measured by reliability, availability, ease of use, and response time.	[9]
Information Quality	IQ	The quality of the content of information systems shows Information Quality. Information quality is measured by the output's completeness, accuracy, relevance, and stability.	[9]
Task Characteristics	TC	Task Characteristics correspond to the pilot's perception of performing a preflight assessment before any flight that is going to occur.	[11]
Technology Characteristics	TEC	Technology characteristics are the digital tools pilots use in preflight planning and how they assess those tools' performance in terms of usefulness, reliability, and completeness.	[11]
Self-Efficacy	SE	Self-efficacy corresponds to the pilot's belief in completing a specific task to reach a particular goal.	[3]
Perceived effectiveness of preflight performance	PP	Corresponds to the perceived performance a pilot has in solving a task as resulting from the interaction between the external representation and a problem-solving task	[11]
Use	USE	Corresponds to the frequency of use of digital tools to perform preflight planning.	[35]
Flying Frequency	FF	Corresponds to the frequency of times a GA pilot flies a GA aircraft.	Ordinal Scale
Flight Hours	FH	Corresponds to the number of hours a pilot has in his logbook.	Ordinal Scale
Years of License	YL	Corresponds to the number of years a pilot holds a license.	Ordinal Scale

Self-Efficacy (SE). Five items assessing confidence in performing preflight tasks (e.g., “I can complete the preflight planning effectively”). Items adapted from established self-efficacy measures to the preflight context. $\alpha = 0.95$. Full items in Appendix A (SE1–SE5). Following indicator screening ($\lambda \geq .70$, cross-loading review), we retained a three-item short form to reduce redundancy and improve parsimony. Despite the reduced length,

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

internal consistency remained high (see Table 3 for α/ρA/CR), and convergent (AVE > .50) and discriminant validity (HTMT < .85) criteria were met. Short, unidimensional scales commonly preserve reliability when items are strongly inter-correlated and content is tightly focused, and are widely used in IS/psychometrics for parsimony and respondent burden reduction. In our data, a sensitivity check using the full initial item set yields substantively similar structural relationships, supporting the adequacy of the three-item form.

Information Quality (IQ). Six items capturing accuracy, completeness, relevance, timeliness, and clarity of information provided by the digital tools (e.g., “The information is accurate and up to date”). Adapted from IS Success measures. $\alpha = 0.93$. Appendix A (IQ1–IQ6).

Technology Characteristics (TEC). Four items reflecting perceived usefulness, portability/integration, stability, and overall favorability of the tools (e.g., “The tool is useful for my preflight planning”). $\alpha = 0.88$. Appendix A (TEC1–TEC4).

System Quality (SQ). Four items on system reliability, availability, ease of use, and response time (e.g., “The system is easy to use”). $\alpha = 0.93$. Appendix A (SQ1–SQ4).

Use of Digital Preflight Tools (USE). Four items capturing frequency/intensity of use (e.g., “I regularly use digital tools during preflight”). $\alpha = 0.88$. Appendix A (USE1–USE4).

Perceived effectiveness of preflight performance (PP): Four items measuring perceived effectiveness/quality of the preflight outcome (e.g., “My preflight plan is thorough and effective”). $\alpha = 0.82$. Appendix A (PP1–PP4).

Demographic variables and aviation experience indicators, including total flight hours, years licensed, age, and flying frequency, were collected to assess their potential moderating or confounding effects.

All measurement items were pre-tested in a pilot study to ensure clarity and contextual appropriateness.

4.4 Data analysis

The analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4. This method was selected due to its robustness in modeling complex relationships with relatively small to medium sample sizes. The model evaluation followed a two-step approach: assessment of the measurement model and the structural model. Reliability and validity were assessed using composite reliability, Cronbach’s alpha, average variance extracted (AVE), and factor loadings. The structural model was evaluated based on path coefficients, t-statistics obtained via bootstrapping (5,000 resamples), and R^2 values. Control variables were included to test their influence on self-efficacy and perceived performance.

Table 2 presents the model constructs. To test the theoretical relationships in the proposed model, we follow structural equation modelling (SEM) by combining statistical data and theoretical causal assumptions. The literature indicates that the widely used structural equation modelling (SEM) method has a supporting methodology in information systems studies [43]. Because covariance-based techniques (CBSEM) may generate inaccurate results or concerns regarding fewer samples due to non-normal distribution, we also used Partial Least Squares (PLS) to understand the causal assumptions better [44]. The PLS method was used with a two-step approach, first for testing the validity and reliability of the measurement model and second for testing the structural model. We used SmartPLS 4.0 software to analyse the two-step approach [45].

4.1 Measurement model assessment

This assessment showed that construct reliability (CR) is more significant than 0.871, showing the model with good internal consistency [46]. The indicator reliability was assessed using the criterion that the loadings should be greater than 0.70 [43]. This is shown in Table 3, where all the loadings are above 0.70, and all values are reliable. We calculated the Average Variance Extracted (AVE) to analyse the convergent validity. The results show that all the AVEs were above 0.68, which means each construct in the model has good convergent validity (Table 3).

Table 3: Criteria quality and loadings.

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)	Discriminant Validaty
IQ	0.931	0.943	0.946	0.744	Yes
PP	0.816	0.846	0.875	0.638	Yes
SE	0.950	0.958	0.961	0.832	Yes
SQ	0.928	0.936	0.949	0.822	Yes
TC	0.781	0.830	0.871	0.693	Yes
TEC	0.877	0.892	0.915	0.731	Yes
USE	0.883	0.916	0.919	0.739	Yes

To examine discriminant validity, we evaluated all item loadings with the cross-loadings. The items considered to meet the criteria are validated (Appendix B). The Heterotrait-Monotrait (HTMT) test [46] was performed, obtaining that all values are below 0.9, so discriminant validity is ensured (Table 4). The items were also subjected to a Fornell & Larcker validity analysis [47], with the results indicating discriminant validity evidence (Table 5). To test the model for multicollinearity issues, we used the variance inflation factor (VIF) [48]. The values shown are below 3.9, with the threshold being 5. It can be assumed that the model does not suffer from multicollinearity. Therefore, the measurement model results show adequate construct, indicator reliability, and convergent and discriminant validity, allowing us to proceed to the second phase of structural model tests.

Table 4: Heterotrait-Monotrait Ratio (HTMT).

	AGE	FF	FH	IQ	PP	SE	SQ	TC	TEC	USE
AGE										
FF	0.064									
FH	0.114	0.066								
IQ	0.130	0.027	0.023							
PP	0.266	0.088	0.042	0.321						

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

SE	0.030	0.073	0.005	0.185	0.097					
SQ	0.201	0.173	0.033	0.739	0.167	0.212				
TC	0.132	0.107	0.074	0.187	0.214	0.317	0.241			
TEC	0.161	0.183	0.132	0.506	0.206	0.178	0.606	0.218		
USE	0.141	0.207	0.021	0.619	0.255	0.061	0.618	0.241	0.471	
YL	0.711	0.041	0.142	0.240	0.235	0.096	0.309	0.116	0.241	0.205

Table 5: Fornell-Lacker criterion.

	AGE	FF	FH	IQ	PP	SE	SQ	TC	TEC	USE
AGE	1.000									
FF	0.064	1.000								
FH	0.114	-0.066	1.000							
IQ	-0.130	-0.025	-0.010	0.863						
PP	-0.250	-0.089	-0.003	0.259	0.799					
SE	0.027	-0.071	0.004	0.163	0.034	0.912				
SQ	-0.192	-0.165	-0.019	0.691	0.135	0.198	0.907			
TC	0.110	0.039	-0.068	0.155	0.171	0.286	0.212	0.832		
TEC	-0.146	-0.172	-0.126	0.463	0.149	0.154	0.549	0.175	0.855	
USE	-0.063	-0.196	0.013	0.592	0.247	0.052	0.580	0.182	0.431	0.860
YL	0.711	0.041	0.142	-0.239	-0.227	0.095	-0.296	0.043	-0.222	-0.215

4.2 Structural model results

The structural model assessment was evaluated with the computation of the Bootstrap and Partial Least Squares algorithms using 5000 sub-samples to determine the impact of paths in the proposed model [40]. Table 6 depicts the structural model results, including the Partial Least Squares estimation results.

Table 6: Structural model results – Hypothesis results.

	Hypothesis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Findings	Conclusion
YL -> SE	H1	0.085	0.061	0.087	0.980	0.327	non-significant	not supported
FH -> SE	H2	0.005	0.041	0.076	0.069	0.945	non-significant	not supported
FF -> SE	H3	-0.086	-0.075	0.077	1.120	0.263	non-significant	not supported
TC -> SE	H4	0.286	0.300	0.097	2.954	0.003	significant;* for p<0.05	supported
AGE -> TEC	H5a	-0.146	-0.148	0.073	1.985	0.047	significant;* for p<0.05	supported
AGE -> USE	H5b	0.055	0.064	0.071	0.774	0.439	non-significant	not supported
TEC -> USE	H6	0.122	0.124	0.086	1.421	0.155	non-significant	not supported
SQ -> USE	H7	0.284	0.275	0.147	1.936	0.053	non-significant	not supported
IQ -> USE	H8	0.346	0.362	0.156	2.218	0.027	significant;* for p<0.05	supported
SE -> PP	H9	0.019	0.042	0.127	0.152	0.879	non-significant	not supported

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

	Hypothesis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Findings	Conclusion
USE -> PP	H10	0.247	0.243	0.126	1.962	0.050	significant;* for p<0.05	supported

The structural model was evaluated using Partial Least Squares Structural Equation Modelling (PLS-SEM). The analysis examined the hypothesised relationships among self-efficacy, information quality, technology characteristics, system quality, and perceived preflight planning effectiveness. Standardised path coefficients, t-statistics, and p-values were used to assess the significance of each path at a 95% confidence level.

Contrary to theoretical expectations and prior research, this study did not find a significant relationship between self-efficacy and perceived effectiveness of preflight performance. Although self-efficacy is widely recognised in the literature as a central predictor of task performance and behavioural engagement [3, 4], the path from self-efficacy to perceived preflight performance was weak and statistically non-significant in this model (β = 0.019, p = 0.879). This diverges from previous findings in aviation psychology that suggest confident pilots can better manage uncertainty and operational complexity, leading to more effective decision-making [22, 49]. One possible explanation is the performance construct employed in this study, which may have captured general perceptions of effectiveness rather than task-specific outcomes. This misalignment may have attenuated the measurable impact of self-efficacy.

The quality of information provided by digital planning tools also emerged as a significant factor, positively predicting the actual use of these tools (β = 0.346, p = 0.027). This result supports existing information systems research that identifies information quality as a primary determinant of technology engagement [9, 10]. Pilots appear more willing to engage with preflight planning systems when the information is perceived as accurate, timely, and relevant.

While some system-related paths were not supported, the results confirmed that use of digital tools influences perceived preflight planning performance (β = 0.247, p = 0.050). This suggests that behavioural engagement with digital systems positively influences pilots' perceptions of planning effectiveness. However, system quality (β = 0.284 p = 0.053) and technology characteristics (β = 0.122, p = 0.155) did not significantly predict the use of digital tools. These findings indicate that functional usability alone may be insufficient to promote tool adoption, reinforcing the need to consider user beliefs and informational quality as primary drivers of digital engagement in general aviation.

The model also incorporated control variables related to pilot experience and demographics. Flight hours (β = 0.005, p = 0.945), years licensed (β = 0.085, p = 0.327), and flying frequency (β = –0.086, p = 0.263) showed no significant effect on self-efficacy. This reinforces emerging evidence that traditional experience indicators are poor predictors of confidence or digital readiness in aviation contexts [17]. Interestingly, age had a significant negative relationship with technology characteristics (β = –0.146, p = 0.047), suggesting generational differences in perceived ease of use and system affinity. However, this did not translate into differential technology use (AGE → USE: β = 0.055, p = 0.439). Figure 2 shows the structural model results.

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

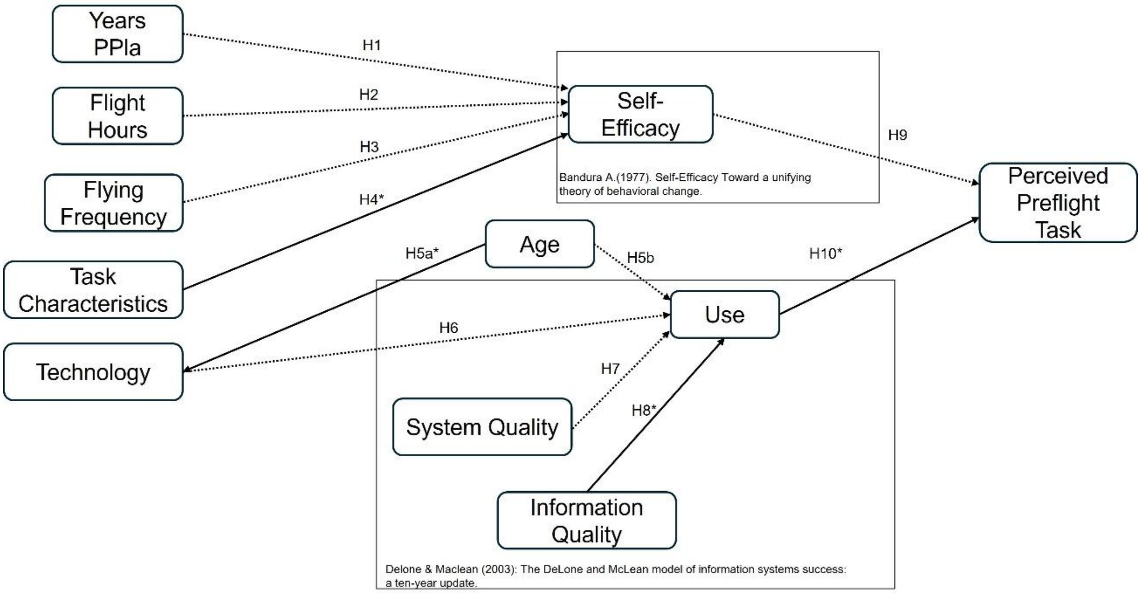

Figure 2: Structural model results.

5. Discussion

This study examined how general aviation (GA) pilots' self-efficacy, perceptions of digital tool quality, and demographic and experiential variables influence their use of technology and perceived preflight planning effectiveness. Contrary to theoretical expectations drawn from Social Cognitive Theory [3] and information systems success models [9], the structural model results offer a more nuanced picture, in which self-efficacy plays a less direct role than hypothesized, and system-related perceptions such as information quality and technology characteristics emerge as more influential.

Our self-efficacy measure uses a three-item short form. While brevity can narrow content coverage, three conditions mitigate this concern here. First, the items were selected from a larger pool using standard indicator criteria and cover the core behaviors of preflight planning (information gathering, synthesis, and plan verification). Second, the scale demonstrates strong reliability and validity in this sample (Table 3; AVE/HTMT/Fornell-Larcker), indicating that the remaining indicators capture a coherent latent construct. Third, the nomological pattern aligns with theory (e.g., task characteristics relate to self-efficacy), which supports construct validity. Even so, future work should consider broader item coverage and tool-specific efficacy items to test whether a longer battery explains additional variance in perceived preflight effectiveness.

The most robust finding was the significant positive effect of information quality (IQ) on using digital tools during preflight planning ($\beta = 0.346$, $p = 0.027$). This supports previous research showing that pilots are more likely to engage with digital platforms when the information they provide is timely, accurate, and relevant [10, 20]. This reinforces the role of high-quality content in enhancing system engagement, consistent with the [9] framework.

Interestingly, Task characteristics (TC) significantly influenced self-efficacy (SE) ($\beta = 0.286$, $p = 0.003$), suggesting that pilots develop more substantial confidence in their planning ability when they perceive the digital tools they use as effective, intuitive, and well-designed. This result aligns with research emphasising that user-centric technology

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

can foster higher perceived competence [49], particularly when it offers transparency and responsiveness in complex operational settings.

However, self-efficacy did not significantly affect perceived planning performance (PP) ($\beta = 0.019$, $p = 0.879$), a finding that diverges from the commonly held assumption that higher task-specific confidence leads to better performance assessments [4, 22]. This may be due to a mismatch between perceived capability and actual tool use, or to the generic phrasing of performance-related survey items that may not have captured task-specific nuances.

Another important result was the significant positive path from use of digital planning tools (USE) to perceived effectiveness of preflight performance (PP) ($\beta = 0.247$, $p = 0.050$). This indicates that when pilots actively engage with digital tools, they perceive their preflight tasks as more effective, validating the argument that structured tool use contributes to higher self-assessed outcomes, at least when supported by quality content.

Demographic and experience-based variables, including flight hours (FH), flying frequency (FF), and years licensed (YL), did not significantly influence self-efficacy. This supports the argument presented by [17] that traditional metrics of pilot experience are increasingly inadequate as predictors of performance or technological readiness. Interestingly, age had a small but significant adverse effect on perceptions of technology characteristics ($\beta = -0.146$, $p = 0.047$), suggesting older pilots may perceive digital tools as less usable or intuitive. However, this did not significantly influence tool use ($\beta = 0.055$, $p = 0.439$).

The findings collectively suggest that perceived system qualities, specifically information quality and technology characteristics, have more explanatory power than experience-based variables or self-efficacy alone. This points to the need for future research and training initiatives to focus more on system usability, information design, and scenario-based tool integration, rather than relying on general flight experience as a proxy for competence.

6. Conclusions, limitations, and future work

This study examined how general aviation (GA) pilots' self-efficacy, perceptions of information and technology quality, and actual use of digital tools contribute to perceived effectiveness in preflight planning. Drawing on Social Cognitive Theory and the DeLone and McLean Information Systems Success Model, the findings suggest that self-efficacy alone may not be the dominant factor in shaping perceived preflight performance, as commonly assumed in the literature. Instead, the results highlight the importance of system-level factors, particularly information quality and technology characteristics, as key enablers of tool engagement and pilot confidence.

Information quality significantly and positively affected the use of digital planning tools, reinforcing the argument that pilots are more likely to engage with preflight systems that offer timely, accurate, and operationally relevant information. Likewise, technology characteristics such as usability and interface design were positively associated with self-efficacy, suggesting that well-designed systems can bolster pilots' task confidence.

---

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

Contrary to expectations, self-efficacy did not significantly influence perceived preflight performance, indicating that confidence in one's capabilities may not translate into perceived planning effectiveness without actual tool use. Digital planning tools significantly influenced perceived performance, supporting the conclusion that behavioural engagement with technology is essential to realising perceived operational value.

Notably, traditional experience-based indicators such as flight hours, years licensed, and flying frequency did not significantly predict self-efficacy. This finding supports emerging perspectives in aviation psychology that question the predictive value of experience metrics in digital operational contexts. Additionally, while age negatively affected perceptions of technology characteristics, it did not significantly influence actual tool use, suggesting that older pilots may view digital tools as less intuitive but do not necessarily avoid them. The findings offer empirical support for a shift toward task-specific, psychologically grounded assessments of pilot readiness and tool effectiveness.

Despite its contributions, this study is not without limitations. First, using self-reported data for both dependent and independent variables raises the possibility of standard method variance and subjective bias. Future research should aim to incorporate objective indicators of digital tool use and preflight performance, such as system log data, simulator-based outcomes, or observational assessments. Second, the study's cross-sectional design limits the ability to infer causality between variables. A longitudinal or experimental approach could better capture dynamic relationships and the evolution of self-efficacy over time. Third, the general conceptualisation of self-efficacy used here may have limited sensitivity to task-specific variations in pilot confidence. A more granular approach, distinguishing between information assessment, risk evaluation, and route planning, for example, may yield richer insights into how self-efficacy functions in the preflight context.

The results also point toward several promising directions for future work. Subsequent studies could explore the mediating and moderating mechanisms through which self-efficacy impacts tool effectiveness, including task complexity, cognitive workload, or time pressure. In addition, there is a strong case for incorporating physiological, behavioural, or simulator-based data to validate self-reported measures and assess how pilots engage with planning tools in operationally realistic environments. The growing use of AI-assisted and adaptive planning platforms presents further opportunities for research, particularly concerning their impact on pilot self-efficacy and performance perceptions. Lastly, the non-significant role of traditional experience metrics invites further exploration into alternative predictors of digital readiness, including digital literacy, adaptive capacity, and exposure to simulation or advanced training technologies.

Funding statement

This work was supported by national funds through FCT (Fundação para a Ciência e a Tecnologia), under the project - UIDB/04152 - Centro de Investigação em Gestão de Informação (MagIC)/NOVA IMS.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

---

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

Aknowledgments

This work was supported by national funds through FCT (Fundação para a Ciência e a Tecnologia), under the project - UIDB/04152 - Centro de Investigação em Gestão de Informação (MagIC)/NOVA IMS.

References:

[1] G. Li, & Baker, S. P., “Correlates of pilot fatality in general aviation crashes,” *Aviation, space, and environmental medicine,* vol. 70(4), 305-309, 1999.

[2] AOPA, “Joseph T. Nall Accident Report,” 2022.

[3] A. Bandura, “ Self-efficacy: toward a unifying theory of behavioral change.,” *Psychological review, 84(2), 191.*, 1977.

[4] Y. Li, Liu, Z., Lan, J., Ji, M., Li, Y., Yang, S., & You, X. , “The influence of self-efficacy on human error in airline pilots: The mediating effect of work engagement and the moderating effect of flight experience. ,” *Current Psychology, 40, 81-92.*, 2021.

[5] D. H. Schunk, & Pajares, F. , “The development of academic self-efficacy.,” *In Development of achievement motivation (pp. 15-31). Academic Press.*, 2002.

[6] W. D. Davis, Fedor, D. B., Parsons, C. K., & Herold, D. M., “The development of self-efficacy during aviation training.,” *Journal of Organizational Behavior, 21(8), 857-871.*, 2000.

[7] S. Ceken, “Cleared for Takeoff: Exploring Digital Assistants in Aviation.,” *In Harnessing Digital Innovation for Air Transportation (pp. 1-24). IGI Global.*, 2024.

[8] M. L. Lopes, M. Aparicio, and F. T. Neves, "Supporting Situational Awareness on Aviation pilots Key insights affecting the use of Electronic Flight Bags devices." pp. p. 1-12 12 p.

[9] W. H. DeLone, & McLean, E. R., “The DeLone and McLean Model of Information Systems Success: A Ten-Year Update,” *Journal of Management Information Systems,* vol. 19, no. 4, pp. 9-30, 2003.

[10] U. Ahlstrom, O. Ohneiser, and E. Caddigan, “Portable Weather Applications for General Aviation Pilots,” *Human Factors,* vol. 58, no. 6, pp. 864-885, 2016.

[11] D. L. Goodhue, & Thompson, R. L., “Task-technology fit and individual performance,” *MIS quarterly, 213-236.*, 1995.

[12] A. Bandura, “Social foundations of thought and action.,” *Englewood Cliffs, NJ, 1986(23-28), 2.*, 1986.

[13] G. Frank, Trespalacios, J., Lowenthal, P., & Snelson, C., “Exploring Influential Factors in Military Instructor Technology Self-Efficacy.,” *TechTrends, 1-13.*, 2025.

[14] R. Parasuraman, and D. H. Manzey, “Complacency and Bias in Human Use of Automation: An Attentional Integration,” *Human Factors,* vol. 52, no. 3, pp. 381-410, 2010.

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

[15] R. Qiu, Gong, Y., Cao, Y., You, X., & Zhu, X., “ Influence of self-efficacy on male military pilots’ capability to handle special situations: a moderated mediation model.,” *Scientific Reports, 13(1), 10794.*, 2023.

[16] M. Martinussen, & Hunter, D. R., “Aviation psychology and human factors. ,” *CRC Press.*, 2017.

[17] S. Gao, & Wang, L., “More experience might not bring more safety: Negative moderating effect of pilots’ flight experience on their safety performance.,” *International Journal of Industrial Ergonomics, 95, 103430.*, 2023.

[18] P. A. Diffenderfer, Baumgartner, D. M., Long, K. M., Pertsch, C. F., & Iacobucci, S. D., “Authentication and authorization challenges for controller-pilot information exchange using mobile devices.,” *In 2020 AIAA/IEEE 39th Digital Avionics Systems Conference (DASC) (pp. 1-8). IEEE.*, 2020.

[19] B. L. Blickensderfer, T. A. Guinn, J. M. Lanicci, Y. Ortiz, J. M. King, R. L. Thomas, and N. DeFilippis, “Interpretability of Aviation Weather Information Displays for General Aviation,” *Aerospace Medicine and Human Performance,* vol. 91, no. 4, pp. 318-325, 2020/04//undefined, 2020.

[20] R. M. Malik, & Indriyanto, T. , “Development of Electronic Flight Bag Application for Small Turboprop Aircraft Weight and Balance Calculation.,” *Warta Penelitian Perhubungan, 35(2), 225-242.*, 2024.

[21] D. G. Heinrich, McAndrew, I., & Pretty, J., “Human Factors Considerations in Satellite Operation's Human-Computer Interaction Technologies: A Review of Current Applications and Theory.,” *arXiv preprint arXiv:2110.04880.*, 2021.

[22] C. G. Özveren, & Ordun, G., “The Relationship Between Pilot Candidates’ Self-Control, Self-Efficacy and Training Performance in Terms of Safety Climate.,” *The International Journal of Aerospace Psychology, 1-26.*, 2023.

[23] S. A. Rizvi, Rehman, U., Cao, S., & Moncion, B., “Exploring technology acceptance of flight simulation training devices and augmented reality in general aviation pilot training. ,” *Scientific Reports, 15(1), 2302.*, 2025.

[24] J. M. King, “An Aviation Weather Preflight Decision Support Tool to Improve Ga Pilot's Preflight and Inflight Performance.,” *Embry-Riddle Aeronautical University.*, 2020.

[25] H. C. Foushee, & Helmreich, R. L., “ Group interaction and flight crew performance. In Human factors in aviation,” *(pp. 189-227). Academic Press.*, 1988.

[26] S. M. Casner, R. W. Geven, and K. T. Williams, “The Effectiveness of Airline Pilot Training for Abnormal Events,” *Human Factors,* vol. 55, no. 3, pp. 477-485, 2013.

[27] J. R. Hackman, & Oldham, G. R., “Motivation through the design of work: Test of a theory.,” *Organizational behavior and human performance, 16(2), 250-279.*, 1976.

[28] E. A. Locke, & Latham, G. P., “New directions in goal-setting theory. ,” *Current directions in psychological science, 15(5), 265-268.*, 2006.

[29] J. M. King, & Blickensderfer, E. L., “Human factors in general aviation weather.,” *In Human Factors in Aviation and Aerospace (pp. 543-562). Academic Press.*, 2023.

---

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

[30] H. Kottl, V. Gallistl, R. Rohner, and L. Ayalon, “"But at the age of 85? Forget it!": Internalized ageism, a barrier to technology use,” *J Aging Stud,* vol. 59, pp. 100971, Dec, 2021.

[31] K. Van Benthem, and C. M. Herdman, “A virtual reality cognitive health screening tool for aviation: Managing accident risk for older pilots,” *International Journal of Industrial Ergonomics,* vol. 85, 2021, 2021.

[32] E. M. Rogers, Singhal, A., & Quinlan, M. M., “Diffusion of innovations.,” *In An integrated approach to communication theory and research (pp. 432-448). Routledge.*, 2014.

[33] V. Venkatesh, Thong, J. Y., & Xu, X., “Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology.,” *MIS quarterly, 157-178.*, 2012.

[34] F. D. Davis, “A technology acceptance model for empirically testing new end-user information systems: Theory and results,” *Doctoral dissertation, Massachusetts Institute of Technology*, 1985.

[35] V. Venkatesh, Morris, M. G., Davis, G. B., & Davis, F. D. , “User Acceptance of Information Technology: Toward a Unified View.,” *MIS Quarterly, 27(3), 425–478*, 2003.

[36] V. Venkatesh, Thong, J. Y., & Xu, X. , “Unified theory of acceptance and use of technology: A synthesis and the road ahead. ,” *Journal of the association for Information Systems, 17(5), 328-376.*, 2016.

[37] L. A. Halawi, McCarthy, R. V., & Aronson, J. E. , “An empirical investigation of knowledge management systems' success.,” *Journal of computer information systems,* vol. 48(2), 121-135., 2008.

[38] W. H. DeLone, & McLean, E. R., “Information systems success revisited,” *Proceedings of the 35th Annual Hawaii International Conference on System Sciences (pp. 2966-2976). IEEE.*, 2002.

[39] C. Tam, and T. Oliveira, “Understanding the impact of m-banking on individual performance: DeLone & McLean and TTF perspective,” *Computers in Human Behavior,* vol. 61, pp. 233-244, 2016.

[40] A. Rai, Lang, S. S., & Welker, R. B., “Assessing the validity of IS success models: An empirical test and theoretical analysis.,” *Information systems research,* vol. 13(1), 50-69., 2002.

[41] K. G. Tippey, T. Roady, C. Rodriguez-Paras, L. J. Brown, W. G. Rantz, and T. K. Ferris, “General Aviation Weather Alerting: The Effectiveness of Different Visual and Tactile Display Characteristics in Supporting Weather-Related Decision Making,” *International Journal of Aerospace Psychology,* vol. 27, no. 3-4, pp. 121-136, 2017.

[42] R. Qiu, Gong, Y., Cao, Y., You, X., & Zhu, X. , “Influence of Self-efficacy on Pilots’ Capability to Handle Special Situations: A Moderated Mediation Model.,” 2023.

[43] Hair, C. M. Ringle, and M. Sarstedt, “Partial Least Squares Structural Equation Modeling: Rigorous Applications, Better Results and Higher Acceptance,” *Long Range Planning,* vol. 46, no. 1-2, pp. 1-12, 2013.

[44] F. Ali, Rasoolimanesh, S. M., Sarstedt, M., Ringle, C. M., & Ryu, K. , “An assessment of the use of partial least squares structural equation modeling

---

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

(PLS-SEM) in hospitality research.," *International journal of contemporary hospitality management, 30(1), 514-538.*, 2018.

[45] C. M. Ringle, Wende,S.,&Will,A., "SmartPLS2.0(beta)." *Available:http://www.smartpls.de.*, 2005.

[46] J. Henseler, C. M. Ringle, and M. Sarstedt, "A new criterion for assessing discriminant validity in variance-based structural equation modeling," *Journal of the Academy of Marketing Science,* vol. 43, no. 1, pp. 115-135, 2014.

[47] C. Fornell, Larcker, D.,, "Evaluating structural equation models with unobservable variables and measurement error.," *Journal of Marketing Research,* vol. 18(1), 39-50, 1981.

[48] J. F. Hair, Sarstedt, M., Ringle, C. M., & Gudergan, S. P., *Advanced issues in partial least squares structural equation modeling*: saGe publications., 2017.

[49] R. Qiu, Gong, Y., Cao, Y., You, X., & Zhu, X. , " Influence of Self-efficacy on Pilots' Capability to Handle Special Situations: A Moderated Mediation Model.," 2023.

Appendix A

Constructs	**Code**	**Indicators**	**Theoretical support**
Task Characteristics	TC	TC1: I always do a preflight briefing everytime anywhere TC2: Everytime I fly I do a thorough preflight everytime everywhere TC4: I always follow all the steps and checklists involved in preflight planning	[11]
Technology Characteristics	TEC	TEC1: Digital tools allow me safe real-time services on preflight planning TEC2: Digital tools give me all the parameters for safe preflight planning TEC3: Digital tools facilitate my preflight planning TEC4: Digital tools provide secure preflight planning	[11]

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

Self-Efficacy	SE	SE1: The level of my capability in preflight planning to successfully finish the job is very high SE2: The level of my understanding about what to do in preflight planning is very high SE3: The level of my confidence in preflight planning tasks is very high SE4: The level of my comfort in preflight planning is very high SE5: In general, the level of my skill in preflight planning is very high	[3]
Perceived Effectiveness of Preflight Performance	PP	PP1: The flight planning digital tools enable me to accomplish my preflight tasks more quickly PP2: The flight planning digital tools make it easier to accomplish my preflight planning tasks PP3: Preflight planning digital tools are useful for preflight planning	[11]
Use	Use	Use1: I use preflight digital tools Use2: I use preflight planning digital tools to store my data Use3: I subscribe to a preflight planning digital tool Use4: I will increase the quality of output of my job	[35]
System Quality	SQ	SQ1: Preflight planning digital tools are easy to navigate SQ2: Preflight planning tools allow me to find the information I am looking for easily SQ3: Preflight planning tools are well structured SQ4: Preflight planning tools are easy to use	[9]
Information Quality	IQ	IQ1: The information provided by preflight planning digital tools is useful IQ2: The information provided by preflight planning digital tools is understandable IQ3: The information provided by preflight planning digital tools is interesting IQ4: The information provided by preflight planning digital tools is reliable IQ5: The information provided by preflight planning digital tools is complete IQ6: The information provided by preflight planning digital tools is up to date	[9]

Appendix B

	AGE	FF	FH	IQ	PP	SE	SQ	TC	TEC	USE	YL
AGE	1.000	0.064	0.114	-0.130	-0.250	0.027	-0.192	0.110	-0.146	-0.063	0.711
FFREQ	0.064	1.000	-0.066	-0.025	-0.089	-0.071	-0.165	0.039	-0.172	-0.196	0.041
FLTHRS	0.114	-0.066	1.000	-0.010	-0.003	0.004	-0.019	-0.068	-0.126	0.013	0.142
PP1	-0.130	-0.044	-0.031	0.317	0.756	0.134	0.170	0.157	0.154	0.136	-0.106
PP2	-0.129	-0.002	-0.047	0.303	0.789	0.060	0.124	0.178	0.203	0.149	-0.108
PP3	-0.338	-0.113	0.030	0.131	0.778	-0.050	0.098	0.078	0.064	0.218	-0.253
PP4	-0.176	-0.097	0.015	0.148	0.866	0.007	0.071	0.150	0.094	0.253	-0.217
IQ1	-0.105	-0.055	-0.002	0.858	0.196	0.123	0.651	0.097	0.449	0.576	-0.205
IQ2	-0.125	0.006	-0.014	0.886	0.201	0.091	0.578	0.134	0.399	0.513	-0.242
IQ3	-0.182	-0.019	-0.012	0.917	0.266	0.084	0.621	0.177	0.432	0.609	-0.269
IQ4	-0.082	-0.023	-0.028	0.862	0.247	0.183	0.570	0.056	0.397	0.483	-0.212
IQ5	-0.138	-0.022	-0.024	0.794	0.204	0.207	0.620	0.158	0.364	0.423	-0.207
IQ6	-0.016	-0.010	0.036	0.854	0.223	0.197	0.526	0.194	0.333	0.406	-0.062
SEFc1	0.070	-0.102	0.013	0.142	0.053	0.893	0.170	0.243	0.130	0.066	0.140
SEFc2	-0.009	-0.039	-0.001	0.183	0.045	0.899	0.176	0.211	0.170	0.056	0.063
SEFc3	0.016	-0.077	-0.003	0.163	0.037	0.937	0.238	0.229	0.142	0.051	0.066
SEFc4	0.005	-0.070	0.004	0.134	0.006	0.900	0.163	0.290	0.147	0.022	0.081
SEFc5	0.032	-0.035	0.003	0.134	0.021	0.932	0.165	0.309	0.122	0.044	0.075
SQ1	-0.203	-0.186	-0.043	0.563	0.109	0.191	0.902	0.184	0.502	0.495	-0.314
SQ2	-0.150	-0.120	0.019	0.643	0.098	0.177	0.882	0.203	0.523	0.610	-0.235
SQ3	-0.133	-0.127	-0.028	0.655	0.127	0.155	0.913	0.170	0.492	0.485	-0.260

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)

SQ4	-0.215	-0.171	-0.027	0.639	0.160	0.194	0.929	0.207	0.463	0.487	-0.271
TASK1	0.197	-0.063	-0.046	0.074	0.079	0.200	0.155	0.823	0.127	0.219	0.150
TASK2	0.062	0.011	-0.073	0.143	0.166	0.294	0.216	0.897	0.212	0.130	0.033
TASK4	0.033	0.163	-0.044	0.169	0.175	0.200	0.145	0.772	0.072	0.120	-0.072
TEC1	-0.085	-0.168	-0.113	0.403	0.069	0.084	0.466	0.107	0.890	0.436	-0.166
TEC2	-0.127	-0.116	-0.070	0.314	0.093	0.151	0.457	0.242	0.867	0.315	-0.171
TEC3	-0.119	-0.148	-0.151	0.453	0.060	0.108	0.507	0.129	0.904	0.406	-0.183
TEC4	-0.184	-0.153	-0.087	0.406	0.324	0.206	0.446	0.144	0.752	0.292	-0.251
USE1	-0.096	-0.123	0.020	0.568	0.203	0.016	0.507	0.101	0.446	0.903	-0.223
USE2	0.039	-0.180	0.012	0.503	0.205	0.122	0.456	0.241	0.379	0.899	-0.134
USE3	0.127	-0.143	0.030	0.312	0.056	0.021	0.377	0.220	0.252	0.743	-0.017
USE4	-0.193	-0.223	-0.006	0.586	0.321	0.022	0.610	0.110	0.372	0.885	-0.289
YEARSPPL	0.711	0.041	0.142	-0.239	-0.227	0.095	-0.296	0.043	-0.222	-0.215	1.000

‡ Corresponding author: Nuno Moura Lopes (nuno.lopes@novaims.unl.pt)