

# A Review of Pilot Performance Literature: Mini-Review Approach

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## Abstract

Today's, many flight accidents are mostly due to the lack of strict efforts to improve safety and too many flight schedules in each region, both in developing countries such as Indonesia and in developed countries. Aircraft accidents are closely related to hardware, software, environment, and people supporting flight operations and flight performance. This study aims to review the literature on the influence of hardware, software, environment, and people (pilot) factors on overall flight performance. It is hoped that the results of this literature study can provide solutions in overcoming the causes of aircraft accidents and overall flight performance. This study uses a qualitative method by analysing the literature of 23 journals related to software, such as regulations, procedures, and company policy programs on aviation performance. Analyse journal literature related to hardware, such as aircraft and supporting equipment, to flight performance and the relationship of environmental influences such as weather, temperature, noise, vibration, and pressure on flight performance and people's effect on flight performance. This study found a significant correlation between software, hardware, environment, and people factors on the performance of aircraft pilots. With these findings, it expected that airlines could pay more attention to hardware, software, environment, and people (pilots) to ensure flight safety by developing aircraft pilots' performance.

## Keywords

Hardware, software, environmental, people, performance and a mini-review approach

## 1. Introduction

The number of plane crash problems occurs because of a problem caused either by the plane itself or by the person operating the aircraft or human error. Peters et al. (2006) said that human error could occur due to errors in design and work procedures, policies and work environment. Also, O'Hagan et al. (2019) noted that flight performance factors are near related to changes in the situational awareness in operating his aircraft. Operating the aircraft for too long by an aeroplane pilot will affect the aircraft pilot's performance due to lack of sleep and fatigue. During rest periods, pilots can be asked to return to work at any time. It often occurs so that pilots become exhausted due to lack of rest time, such as lack of sleep resulting in jet lag, illness, and psychological disorders such as stress and emotions. The performance of a pilot can be seen from how he can control the aircraft during RTO manoeuvres. This ability is one indicator of pilot performance. The ability to keep the plane centred on the runway and implement safe flight procedures is a pilot's performance (Allen et al., 2018).

Another factor that can cause a decrease in concentration or mood is the noise factor. The cumulative noise factor will cause a pilot to lose concentration in operating the aircraft (Ivošević et al., 2018). Chronic exposure to cumulative noise above 40% of the required will trigger long-term changes in pilot performance. However, various flight elements or environmental factors of varying complexity, such as vibrations or other flight-related forces, can affect pilot performance (Breliastriti et al., 2018). Furthermore, other factors that can cause accidents or human error from a pilot are deregulation and company policies. Kim and Rhee (2017) indicated that the greater the proportion of policies and regulations appropriately discussed internally, the airline would more likely learn from its accidents and experience the next accident rate is the lower one. Besides, the moderating effect of performance feedback suggests that airlines performing below their aspiration level are more likely to learn from internally attributed crash causes and experience a subsequent lower accident rate. Another element that significantly affects pilots' performance and the company, in general, is aviation deregulation. Setiawan et al. (2015) stated that deregulation generally has a positive effect on pilot performance and commercial airlines' performance.

Another element that affects a pilot's performance is the overloaded demands of the job, which is detrimental to pilots because it makes pilots more tired and less able to organise their work. Also, fatigue was negatively related to pilot happiness. Psychosocial and health factors are important and valuable factors for pilots and airlines (Demerouti et al., 2018). According to Susanti and Nurhayati (2014), several factors cause a pilot's fatigue, namely (a) making a connecting flight, (b) making a delayed night flight or evening flight, (c) boredom, (d) an increase in workload, and (e) physical environmental factors such as temperature, humidity, noise, pressure, shock, long distances between the house or resting place and the airport were on duty. These factors will significantly reduce a pilot's performance so that there is a strong possibility of human error in operating the aircraft.

The provision of useful and quality aviation support tools in flight operations and flight training management, carried out continuously, can encourage pilot operation performance in a better, more comprehensive and effective manner (Liu et al., 2018). The provision of a flying skills manual is one way for companies to improve pilot performance (Haslbeck et al., 2018). According to Landman et al. (2017), it takes more time, effort and financial resources to train them to fly aircraft safely. Although environmental and structural factors can affect flight safety, pilot overload remains the single greatest functional limitation to achieving a thoroughly reliable and error-free system. Thus, a sensitive method is needed to monitor the pilot's duty load and improve aviation safety (Diaz-Piedra et al., 2019). The present study aims to comprehend the review literature on the influence of hardware, software, environment, and people (pilot) factors on overall flight performance from various sources and summary results and conclusions based on the findings.

## Method

This mini-review was conducted by reading through and analysing 23 peer-reviewed journal articles related to the influence of hardware, software, environment, and people (pilot) factors on overall flight performance. These articles are summarised in the tables below. The first table presents the journal article's information regarding the title, authors, publishers, and the publication year. The second table represents the contents of the journal articles, including the study's objectives, the findings, and the recommendations.

**Table 1.** Journal and Publisher Distribution

No	Article Name	Author(s)	Journal	Publisher	Year
1	Flying on empty—effects of sleep deprivation on pilot performance	O'Hagan, A. D., Issartel, J., Wall, A., Dunne, F., Boylan, P., Groeneweg, J., & Warrington, G.	Biological Rhythm Research	Taylor and Francis Ltd.	2019
2	Effects of interior aircraft noise on pilot performance	Jurica Ivošević, Tino Bucak, Petar Andrašić	Applied Acoustics	Elsevier	2018
3	Airplane pilot flight performance on 21 maneuvers in a flight simulator under varying carbon dioxide concentrations.	Allen, J. G., MacNaughton, P., Cedeno-Laurent, J. G., Cao, X., Flanigan, S., Vallarino, J., & Spengler, J. D.	Journal of Exposure Science & Environmental Epidemiology	Springer Nature	2017

4	Eye-Tracking Measures in Aviation: A Selective Literature Review	Peißl, S., Wickens, C. D., & Baruah, R.	The International Journal of Aerospace Psychology,	Routledge Taylor & Francis Group	2018
5	How airlines learn from airline accidents: An empirical study of how attributed errors and performance feedback affect learning from failure.	Kim, E., & Rhee, M.	Journal of Air Transport Management,	Science Direct	2017
6	Assessing the sharp end: reflections on pilot performance assessment in the light of safety differently	David E. Weber & Sidney W.A. Dekker	Theoretical Issues in Ergonomics Science	Taylor & Francis	2016
7	Burnout among pilots: psychosocial factors related to happiness and performance at simulator training.	Demerouti, E., Veldhuis, W., Coombes, C., & Hunter, R.	Ergonomics,	Taylor & Francis	2018
8	Aviation Deregulation and Performance of Scheduled Commercial Aviation Companies in Indonesia	Indra Setiawan, Dewi Nusraningrum, Yosi Pahala.	Jurnal Manajemen Transportasi & Logistik (JMTransLog)	Manajemen Transportasi & Logistik (JMTransLog)	2015
9	The Level of Fatigue of The Indonesia Pilots in Flying the Commercial Aircraft on Short Route	Susanti dan Yati Nurhayati.	Jurnal Perhubungan Udara	Departement Perhubungan	2014
10	Factors contributing to the risk of airline pilot fatigue	Seungyoung Lee, Jin Ki Kim	Journal of Air Transport Management	Elsevier Ltd. All rights reserved	2018
11	Method for measuring factors that affect the performance of pilots	Michelle C.G.S.P. Bandeira, Anderson Ribeiro Correia, Marcelo Ramos Martins	Transportes	Associação Nacional de Pesquisa e Ensino em Transportes	2017
12	Methodology for assessing dependencies between factors influencing airline pilot performance reliability: A case of taxiing tasks.	Wang, L., Wang, Y., Chen, Y., Pan, X., Zhang, W., & Zhu, Y.	Journal of Air Transport Management,	Elsevier Ltd.	2020
13	A System for Evaluating Pilot Performance Based on Flight Data.	Liu, S., Zhang, Y., & Chen, J. (2018)	Lecture Notes in Computer Science	Civil Aviation University of China	2018
14	Manual flying skills under the influence of performance shaping factors	Haslbeck, A., Schubert, E., Onnasch, L., Hüttig, G., Bubb, H., & Bengler, K.	Work	IOS Press	2012
15	Pilot Flying and Pilot Monitoring's Aircraft State Awareness During Go-Around Execution in Aviation: A Behavioral and Eye Tracking Study	Dehais, F., Behrend, J., Peysakhovich, V., Causse, M., & Wickens, C. D.	The International Journal of Aerospace Psychology	Taylor & Francis Group	2017
16	Influences of age, mental workload, and flight experience on cognitive performance and prefrontal activity in private pilots: a fNIRS study	Causse, M., Chua, Z. K., & Rémy, F.	Scientific Reports	Nature Publishing Group	2019

17	Attentional Blink in Pilots and Its Relationship with Flight Performance	Fengzhan, L., Liu, Q., Lu, H., & Zhu, X.	Frontiers in Psychology	Frontiers Media S.A.	2007
18	Acute Mild Hypoxic Hypoxia Effects on Cognitive and Simulated Aircraft Pilot Performance	Bouak, F., Vartanian, O., Hofer, K., & Cheung, B.	Aerospace medicine and human performance	Aerospace Medical Association	2018
19	The effects of flight complexity on gaze entropy: An experimental study with fighter pilots	Diaz-Piedra, C., Rieiro, H., Cherino, A., Fuentes, L. J., Catena, A., & Di Stasi, L. L.	Applied Ergonomics	Elsevier	2019
20	Greening the airline pilot: HRM and the green performance of airlines in the UK.	Harvey, G., Williams, K., & Probert, J.	International Journal of Human Resource Management,	Routledge	2013
21	Multitasking as a Predictor of Pilot Performance: Validity Beyond Serial Single-Task Assessments.	Barron, L. G., & Rose, M. R.	Military Psychology,	Routledge Taylor Francis Group	2017
22	Aircraft Pilots Workload Analysis: Heart Rate Variability Objective Measures and NASA-Task Load Index Subjective Evaluation	Andrea Alaimo et al.,	Aerospace	MDPI	2020
23	Novel Estimation of Pilot Performance Characteristics.	Bachelder, E., & Aponso, B. L.	AIAA Atmospheric Flight Mechanics Conference.	AIAA SciTech Forum	2017

**Table 2.** Articles Category Based on the Subject

No	Article Name	Objectives	Findings	Recommendations
1	Flying on empty. Effects of sleep deprivation on pilot performance	To examine the effects of 24 h' sleep deprivation on a variety of psychological measures, cognitive performance tasks and simulated flight.	Flying performance was not significantly impaired. Changes in flight performance were found to be consistent with changes in situational awareness. Overall findings showed impairments in mood, cognition and flying performance following 20 hours of continuous wakefulness. SA indicates promise as a potential indicator of changes in flying performance as a result of sleep deprivation and fatigue	

2	Effects of interior aircraft noise on pilot performance	To examine the cumulative influence of the interior noise of a light, propeller-driven, single-piston engine aircraft on operation-related performance of 14 civil pilots aged 22–26 years with 165–350 flight hours of experience.	The self-report questionnaire results and objective performance in flight simulations suggest that cumulative noise exposure may not significantly affect pilot aviating and navigating tasks.	Further research needs to examine whether exposure to noise above this level can impact performance.
3	Airplane pilot flight performance on 21 maneuvers in a flight simulator under varying carbon dioxide concentrations	To investigate airplane pilot flight performance on 21 maneuvers in a flight simulator under varying carbon dioxide concentrations	Compared to segments at a CO <sub>2</sub> concentration of 2500 ppm, the odds of passing a maneuver as rated by the Examiner in the simulator were 1.52 (95% CI: 1.02–2.25) times higher when pilots were exposed to 1500 ppm and 1.69 (95% CI: 1.11–2.55) times higher when exposed to 700 ppm, controlling for maneuver difficulty, Examiner and order of	It is recommended for sampling research not only limited to male pilots but to female pilots as well. This test only on tests can be done on different aircraft types
4	Eye-Tracking Measures in Aviation: A Selective Literature Review)	To examine the cumulative influence of the interior noise of a light, propeller-driven, single-piston engine aircraft on the operation-related performance of 14 civil pilots aged 22–26 years with 165–350 flight hours of experience	The self-report questionnaire results and objective performance in flight simulations suggest that cumulative noise exposure may not significantly affect pilot aviating and navigating tasks.	Further studies are eventually needed to verify and extend these results with higher cumulative noise exposure, more noise dose sequences and greater number of more experienced pilots.
5	How airlines learn from airline accidents: An empirical study of how attributed errors and performance feedback affect learning from failure	To examine organisational learning factors by asking whether airlines learn more from internally or externally attributed causes of airline accidents. Our dependent variable, organisational	The findings of this research revealed that the greater the proportion of internally attributed causes is, the more likely it is that an airline will learn from its accidents and will experience a lower subsequent accident rate. Also, our findings regarding the moderating effect of performance feedback showed that airlines performing below their aspiration levels are	Our research findings provide implications for future studies that discuss the factors affecting organisational learning

		learning, was defined as a decrease in subsequent airline accident rates.	more likely to learn from internally attributed causes of accidents and will therefore experience a lower subsequent accident rate.	
6	Assessing the sharp end: reflections on pilot performance assessment in the light of safety differently	To analyse the practice of assessing various airline pilots' performance with very specific and very non-specific categories.	Based on this research, the aviation industry has two choices in dealing with the diversity of assessors' assessment and reasoning. The first option is to continue pursuing high inter-rater reliability measures in assessment scores and to fight against variability in rater rationale. However, the study findings outlined in this study suggest a slim chance of success. It may be very difficult if not impossible to eliminate all variance in rater's observations, evaluations, and interpretations	It is questionable whether increased agreement among assessors or diversity in assessors' reasoning can provide a more colourful pilot performance picture.
7	Burnout among pilots: psychosocial factors related to happiness and performance at simulator training.	To investigate the work characteristics (job demands and resources) and the outcomes (job crafting, happiness and simulator training performance) that are related to burnout for this occupational group	Job demands are detrimental to simulator training performance by making pilots more tired and less able to structure their jobs. In contrast, job resources have a beneficial effect because they reduce feelings of disengagement and increase work arrangement. Besides, fatigue was negatively related to pilot happiness. These findings highlight the importance of psychosocial and health factors for valuable outcomes for pilots and airlines	
8	Aviation Deregulation and Performance of Scheduled Commercial Aviation Companies in Indonesia	To analyse the aviation deregulation and performance of the scheduled commercial airlines	Airline deregulation affects company performance	
9	The Level of Fatigue of The Indonesia Pilots in Flying the Commercial Aircraft on Short Route	To examine the fatigue of pilots who fly commercial aircraft on short route since they	The results indicate that the pilots experience fatigue when flying short routes in their duty time, and the factor that contributes the most to the pilots' fatigue is the	Further research needs to pay attention to other variables that develop as a contributor to pilot fatigue.

		have to make several take-off and landing during their duty time for short route flight	external factor related to their duty as a pilot.	
10	Factors contributing to the risk of airline pilot fatigue	To identify factors that affect airline pilot fatigue. This study proposes a fatigue model for airline pilots. fatigue is classified into physical decline, mental decline, and rest defects.	These findings can contribute to reducing pilot fatigue, which is important in aviation in terms of physical fatigue, mental decline, and rest defects.	It is suggested in further research to analyse more deeply about the factors causing general fatigue
11	Method for measuring factors that affect the performance of pilots	To develop the accident analysis model according to the main factors that influence aeronautical accidents, capable of evaluating any aircraft accident, taking into account factors of human, organisational, environmental and airport infrastructure	The results show the relationship between the factors that can influence the pilots' performance and, therefore, indicate how this can affect the success or failure of tasks related to flight procedures	For further research, it is suggested to include the factors related to the failure of components in aircraft systems to be considered in further analysis
12	Methodology for assessing dependencies between factors influencing airline pilot performance reliability: A case of taxiing tasks.	To develop a methodology incorporating both state and effect dependencies between contributory factors into HRA for airline pilot tasks based on fuzzy logic and the Cognitive Reliability and Error Analysis Method (CREAM)	The results demonstrate the validity of the proposed methodology and its capability of representing the ambiguity and fuzziness of expert judgement.	
13	A System for Evaluating Pilot Performance Based on Flight Data.	To develop a flight operation performance evaluation system based on QAR data and a quantitative evaluation method model. In this	The system provides a support tool for flight operations quality monitoring and flight training management. The system can evaluate the pilot's operation performance from multiple dimensions, which is more objective, effective, and reasonable. It will give a	

		<p>model, one or several of the flight parameters could be selected for combination to evaluate the pilot's performance of flight operations objectively.</p>	<p>warning earlier and suggestions for improvement so that we can arrange follow-up training for the pilot. The airline's performance rewards and punishments would get a more accurate and objective basis from this system. The system provides actual data support for flight operation department to monitor flight risk. It provides an effective basis and reference for the flight training department to arrange targeted improvement training. However, the system needs to be improved for shortening its response time and processing.</p>	
14	<p>Manual flying skills under the influence of performance shaping factors</p>	<p>To investigate pilots' manual flying skills. In today's line oriented flight training, basic flying skills are neglected frequently. So, the study examines the manual flying skills of commercial airline pilots under the influence of several performance shaping factors like training, practice or fatigue in a landing scenario</p>	<p>Manual flying skills affect the pilot's performance</p>	
15	<p>Pilot Flying and Pilot Monitoring's Aircraft State Awareness During Go-Around Execution in Aviation: A Behavioral and Eye-Tracking Study</p>	<p>To examine performance and visual scanning of aircrews during final approach and an unexpected go-around manoeuvre</p>	<p>The pilot performance results showed that two-thirds of the crews committed errors, including critical trajectory deviations during go-arounds, a the precursor of accidents. Eye-tracking analyses revealed that the cross-checking process was not always efficient in detecting flight-path deviations when they occurred. Ocular data also highlighted different visual strategies between the 2 crew members during the 2 flight phases</p>	<p>Further studies are needed to confirm these findings because our sample size is small. Also, relevant for manipulating other variables, such as dial versus glass cockpit rotation, low versus high-level automation, or experienced pilots versus newly trained pilots, to decipher</p>



				any variables that might affect visual scanning
16	Influences of age, mental workload, and flight experience on cognitive performance and prefrontal activity in private pilots: a fNIRS study	To determine the effect of pilotage on flight performance. The researchers included two age groups as samples in the trial, namely the young pilot group and the old pilot group.	The results confirmed the overall effect of difficulty levels in the three age groups, with decreased task performance and increased prefrontal HbO2 signalling. Older pilots' performance against younger pilots was impaired on both tasks, with the largest decreases being observed for the highest load Spatial Working Memory task. Consistent with this behavioural deficit in older pilots, a plateau of prefrontal activity was observed at this highest load level, indicating that an upper limit of nerve resource has been reached.	
17	Attentional Blink in Pilots and Its Relationship with Flight Performance	To investigate the Attentional Blink effect in military pilots and its relationship with flight performance	There is a significant correlation between the Blinking Attention effect and the lowest flight performance score for military pilots	It takes more time, effort and financial resources to train them to fly the aircraft safely. Future longitudinal studies need to verify by exerting efforts and financial resources to train cadet candidates and exclude those who are unable to suppress distraction stimuli or are prone to overlook important information.
18	Acute Mild Hypoxic Hypoxia Effects on Cognitive and Simulated Aircraft Pilot Performance	To investigate the effects of acute mild hypoxic hypoxia (HH) and physical activity on physiological measures, signs and symptoms, mood, fatigue, cognition, and performance on a simulated flight task	Symptoms of increased altitude, negative mood, general fatigue, and physical exhaustion, and decreased pilot performance	Baseline subjective measures at GL should be included in future empirical investigation
19	The effects of flight complexity on gaze entropy: An experimental study with fighter pilots	We studied the effects of task load variations as a function of flight complexity on	This study's finding was that the pilot's gaze entropy decreased by ~2% (i.e., the visual scan became less erratic) upon completing emergency	

		combat pilots' gaze behavior (i.e., entropy) while solving in-flight emergencies.	flight drills, indicating a significant downward trend with increasing complexity.	
20	Greening the airline pilot: HRM and the green performance of airlines in the UK.	To investigate the potential for human resource management (HRM) to influence the green performance of airlines.	As a result, the HR function must find ways to engage them in the greening of the organisation and reduce the triggers to actions that have the potential to sabotage the green aims of the airline industry. To this end, the paper discusses first the indirect effects of HRM in terms of its influence on employee job satisfaction, commitment and involvement in the airline, which can reduce the propensity of pilots to engage in actions detrimental to the green performance of the airline	Future research might further explore the eclectic nature of the contribution of HRM to the green performance of the firm, both in its direct and indirect effects. Moreover, studies might interrogate the relationship between how HRM contributes to the performance of the firm to understand better the influence of one type of measures (indirect) on the other (direct)
21	Multitasking as a Predictor of Pilot Performance: Validity Beyond Serial Single-Task Assessments.	To validate a pre-job multitasking assessment (with math, rote memorisation, and monitoring assignments.	The results show the potential use of multitasking assessments in selecting military jobs that require competition, the demands of concurrent duties that will drive each pilot's performance.	Further studies can design iterative action studies and ensure control for potential motivational and regularity effects, such as placing single task serial operational measures at the start and end of the assessment.
22	Aircraft Pilots Workload Analysis: Heart Rate Variability Objective Measures and NASA-Task Load Index Subjective Evaluation	To analyse the relationships between objective and subjective workload.	The relationship between other HRV index analyses, both in time and frequency domains, and pilot performance was very significant	Further studies can estimate other HRV indices' analysis, both in time and frequency domains, during different flight segments characterised by workload levels ranging from very low to critical.

23	Novel Estimation of Pilot Performance Characteristics	To assess pilot workloads and their variation over time across various tasks.	The nonlinear pilot control technique, observed and coined by the authors as 'amplitude clipping', improves stability and performance and reduces the workload when used with vehicle dynamics requiring high lead compensation by pilots.	Further studies can analyse the Cooper-Harper ranking based on workload and parameter estimation methodology.
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### 3. Result and Discussion

The results of this study indicated that several problems affect a pilot's performance in operating the aircraft. Empirically, the results of previous studies discussed in this mini-review show several factors, either directly or indirectly, affecting a pilot's performance—first, the software factors such as regulation, procedure, and policy program. Second, hardware factors, such as aircraft and supporting equipment. The third is the environment, such as weather, temperature, vibration and pressure, and the third is the person or skill factor of the pilot himself.

Changes in a pilot's awareness will significantly determine changes in a pilot's performance. For example, a decrease in mood, cognition, and flight performance continuously for 20 hours will change in-flight performance in pilots due to lack of sleep and fatigue (O'Hagan, 2019). Apart from workload overload, noise factors as a contributing factor to lower pilot performance. Cumulative noise may not significantly affect pilot duties and pilot navigation. Higher cumulative noise significantly reduces the performance of a pilot (Ivošević. 2018). A similar finding was found by Breliastiti (2018), the noise would disturb the pilot's concentration, thereby reducing the pilot's performance in operating the aircraft. One indicator of pilot performance is keeping the aircraft centred on the runway and flying safely (Allen, 2018).

Other things that can affect the performance of a pilot are deregulation and company policy programs. These two factors significantly affect psychology and performance in operating his aircraft (Kim and Rheem, 2017). Aviation deregulation, in general, has a positive effect on the performance of pilots and the performance of commercial airlines (Indra Setiawan, 2015). The performance of a pilot will decrease due to fatigue, both psychologically and physically. Several fatigue factors are significantly affecting a pilot's performance, namely making a connecting flight, having a delayed night or evening flight, boredom, and an increase in workload. The physical environmental factors are temperature, humidity, noise, pressure, shock, long distances between the house or resting place and the airport where they are on duty (Susanti and Nurhayati, 2014). The relationship between fatigue and decreased pilot performance was confirmed by Lee et al. (2018), Michelle et al. (2017), Wang et al. (2020) and Bouak et al. (2018).

Furthermore, in this mini-review, the relationship between the effect of training on aircraft pilots' performance is also found. Training is carried out regularly and well managed are a factor in increasing pilots' ability in their duties. So, they would have better the ability to operate the aircraft, the better the performance of an aeroplane pilot in operating the aircraft, as confirmed by Piedra et al. (2019), Landman et al. (2017), and Wang et al. (2020).

Finally, the relationship between supporting infrastructure for the smooth running of flights such as people, tools and flight manuals are an element that can significantly affect the performance of an aeroplane pilot. Aviation support personnel and equipment can improve the quality of flight operations and flight training management, which improves the ability and performance of pilots in operating aircraft. It is as confirmed by Liu et al. (2018), Haslbeck (2012), Dehais et al. (2017), Causse et al. (2019), Piedra et al. (2019), Harvey (2013), Barron et al. (2017), Alaimo et al. (2020) and Bachelder, E. (2017)

### 4. Conclusion

This study found a significant correlation between software, hardware, environment, and people factors on the performance of aircraft pilots. With these findings, it expected that airlines could pay more attention to hardware, software, environment, and people (pilots) to ensure flight safety by developing aircraft pilots' performance. In conclusion, software such as regulation, procedure, and policy program affects aircraft pilots' performance. Hardware such as aircraft and supporting equipment has significantly improved the performance of aircraft pilots. Finally, the environment and people can substantially affect aircraft pilots' performance in operating their aircraft.

## References

- Alvarez, L., Classen, S., Medhizadah, S., Knott, M., & He, W. . (2018). Pilot Efficacy Of A Drivefocus™ Intervention On The Driving Performance Of Young Drivers. . *Frontiers In Public Health*, 6. Doi:10.3389/Fpubh.2018.00125 / Wwww.Frontiersin.Org.
- Andrea Alaimo, Antonio Esposito, Calogero Orlando And Andre Simoncini. (2020). Aircraft Pilots workload Analysis: Heart Rate Variability Objective Measures And NASA-Task Load Index Subjective Evaluation. *Aerospace* , 7, 137; Doi:10.3390/Aerospace7090137.Wwww.Mdpi.Com/Journal/Aerospace.
- Anna Donnla O'Hagan, Johann Issartel, Aidan Wall, Friedrich Dunne, Patrick Boylan, Jaap Groeneweg, Matthew Herring, Mark Campbell & Giles Warrington. (2019). "Flying On Empty" – Effects Of Sleep Deprivation On Pilot Performance . *Biological Rhythm Research*, 10.1080/09291016.2019.1581481/ISSN: 0929-1016 (Print) 1744-4179 (Online) Journal Homepage: <https://www.tandfonline.com/loi/nbr20>/Taylor & Perancis.
- Bachelor, E., & Aponso, B. L. . (2017). Novel Estimation Of Pilot Performance Characteristics. . *AIAA Atmospheric Flight Mechanics Conference*, Doi:10.2514/6.2017-1640 /AIAA Scitech Forum.
- Barron, L. G., & Rose, M. R. . (2017). Multitasking As A Predictor Of Pilot Performance: Validity Beyond Serial Single-Task Assessments. . *Military Psychology*, 29(4), 316–326. Doi:10.1037/Mil0000168 /ISSN: 0899-5605 (Print) 1532-7876/Routledge Taylor Franciscgroup.
- Carolina Diaz-Piedraa, B, Hector Rieiroa, Alberto Cherinoc, Luis J. Fuentesd, Andres Catena, Leandro L. Di Stasia. (2019). The Effects Of Flight Complexity On Gaze Entropy: An Experimental Study With Fighter Pilots. *Applied Ergonomics*, 77 . 92–99. <https://doi.org/10.1016/j.apergo.2019.01.012>/Elsevier.
- David E. Weber & Sidney W.A. Dekker. (2016). Assessing The Sharp End: Reflections On Pilot Performance Assessment In The Light Of Safety Differently. *Theoretical Issues In Ergonomics Science*, DOI: 10.1080/1463922X.2016.1149253/Taylor & Francis.
- Dehais, F., Behrend, J., Peysakhovich, V., Causse, M., & Wickens, C. D. (2017). Pilot Flying And Pilot Monitoring's Aircraft State Awareness During Go-Around Execution In Aviation: A Behavioral And Eye Tracking Study. *The International Journal Of Aerospace Psychology*, 27:1-2, 15-28, DOI: 10.1080/10508414.2017.1366269/ISSN: 2472-1840 (Print) 2472-1832 (Online) Journal/Taylor & Francis Group.
- Demerouti, E., Veldhuis, W., Coombes, C., & Hunter, R. . (2018). Burnout Among Pilots: Psychosocial Factors Related To Happiness And Performance At Simulator Training. *Ergonomics*, 1–13. Doi:10.1080/00140139.2018.1464667 .ISSN: 0014-0139 (Print) 1366-5847 Taylor & Francis.
- Fengzhan Li, Quanhui Liu, Huijie Lu And Xia Zhu. (2020). Attentional Blink In Pilots And Its Relationship With Flight Performance. *Frontiers In Psychology*, 11:1696. Doi: 10.3389/Fpsyg.2020.01696. Attentional Blink In Military Pilots.
- Fethi Bouak; Oshin Vartanian; Kevin Hofer; Bob Cheung. ( 2018). Acute Mild Hypoxic Hypoxia Effects On Cognitive And Simulated Aircraft Pilot Performance. *Aerospace Medicine And Human Performance* , Vol. 89, No. 6 June. DOI: <https://doi.org/10.3357/AMHP.5022.2018>/By The Aerospace Medical Association, Alexandria, VA.
- George A. Peters, Barbara J. Peters. (2006). *Human Error; Causes And Control*. 6000 Broken Sound Parkway NW, Suite 300. Boca Raton, FL 33487-2742: CRC Press. Taylor & Francis Group.
- Hamblin Et Al. (2017). EVALUATION OF PILOT PERFORMANCE USING COLLECTED AVIONICS SYSTEM DATA. *United States Patent Application Publication* , Jul. 27, . Sheet 3 Of 6 US 2017/0210483 A1.
- Harvey, G., Williams, K., & Probert, J. (. (2013). Greening the Airline Pilot: HRM And The Green Performance Of Airlines In The UK. . *The International Journal Of Human Resource Management* , 24(1), 152–166. Doi:10.1080/09585192.2012.669783 Routledge.
- Haslbeck, Andreas , Schubert, Ekkehart , Onnasch, Linda , Hüttig, Gerhard , Bubb, Heiner , Bengler, Klaus. (2012). Manual Flying Skills Under The Influence Of Performance Shaping Factors. *IOS Press*, Vol. 41, No. Supplement 1, Pp. 178-183, 2012. DOI: 10.3233/WOR-2012-0153-178/IOS Press And The Authors. .
- Hung, A. J., Chen, J., Jarc, A., Hatcher, D., Djaladat, H., & Gill, I. S. (2018). Development And Validation Of Objective Performance Metrics For Robot-Assisted Radical Prostatectomy: A Pilot Study. *The Journal Of Urology*, 199(1), 296–304. Doi:10.1016/J.Juro.2017.07.081/University Of Southern California Institute Of Urology.
- Indra Setiawan, Dewi Nusraningrum, Yosi Pahala. (2015). Aviation Deregulation And Performance Of Scheduled Commercial Aviation Companies In Indonesia. *Jurnal Manajemen Transportasi & Logistik (Jmtranslog)*, Vol. 02 No. 01, Maret .ISSN 2355-4721.
- Joseph G. Allen, Piers Macnaughton, Jose Guillermo Cedeno-Laurent, Xiaodong Cao, Skye Flanigan. (2018). Airplane Pilot Flight Performance On 21 Maneuvers In A Flight Simulator Under Varying Carbon Dioxide

- Concentrations. *Journal Of Exposure Science & Environmental Epidemiology*, Doi:10.1038/S41370-018-0055-8 Springer Nature.
- Jurica Ivošević, Tino Bucak, Petar Andrašić. (2018). Effects Of Interior Aircraft Noise On Pilot Performance. *Applied Acoustics*, 139.8–13/Doi:10.1016/J.Apacoust.2018.04.006 /Elsevier Ltd. All Rights Reserved.
- Kim, E., & Rhee, M. (2017). How Airlines Learn From Airline Accidents: An Empirical Study Of How Attributed Errors And Performance Feedback Affect Learning From Failure. . *Journal Of Air Transport Management*, , 58, 135–143. Doi:10.1016/J.Jairtraman.2016.10.007sciencedirect.
- Landman, A., Groen, E. L., Van Paassen, M. M. (René), Bronkhorst, A. W., & Mulder, M. (2017). The Influence Of Surprise On Upset Recovery Performance In Airline Pilots. *The International Journal Of Aerospace Psychology*,, 27(1-2), 2–14. Doi:10.1080/10508414/Routledge Taylor Francis Group.
- Liu, S., Zhang, Y., & Chen, J. . (2018). A System For Evaluating Pilot Performance Based On Flight Data. . *Lecture Notes In Computer Science*, 605–614. Doi:10.1007/978-3-319-91122-9\_49 .Civil Aviation University Of China, Tianjin 300300, China.
- Michelle C. G. S. P. Bandeira, Anderson Ribeiro Correia, Marcelo Ramos Martins. (2017). Method For Measuring Factors That Affect The Performance Of Pilots. *TRANSPORTES*, ISSN: 2237-1346DOI:10.14295/Transportes.V25i2.1374.Anpet.
- Mickaël Causse, Zarrin K. Chua & Florence Rémy. (2019). Influences Of Age, Mental Workload, And Flight Experience On Cognitive Performance And Prefrontal Activity In Private Pilots: A Fnirs Study. *Scientific Reports*, 9:7688 | <https://doi.org/10.1038/S41598-019-44082-W>/[www.nature.com/scientificreports](http://www.nature.com/scientificreports).
- Peißl, S., Wickens, C. D., & Baruah, R. . (2018). Eye-Tracking Measures In Aviation: A Selective Literature Review. *The International Journal Of Aerospace Psychology*,, 1–15. Doi:10.1080/24721840.2018.1514978ISSN: 2472-1840 (Print) 2472-1832. Routledge Taylor & Francis Group.
- Seungyoung Lee, Jin Ki Kim. (2018). Factors Contributing To The Risk Of Airline Pilot Fatigue . *Journal Of Air Transport Management*, 67, 197–207.<https://doi.org/10.1016/J.Jairtraman.2017.12.009/0969-6997/> © 2018 Elsevier Ltd. All Rights Reserved.
- Seungyoung Leea, Jin Ki Kimb. (2018). Factors Contributing To The Risk Of Airline Pilot Fatigue . *Journal Of Air Transport Management*, 67 (2018) 197–207/<https://doi.org/10.1016/J.Jairtraman.2017.12.009/Elsevier>.
- Susanti Dan Yati Nurhayati. (2014). The Level Of Fatigue Of The Indonesia Pilots In Flying The Commercial Aircraft On Short Route. *Jurnal Perhubungan Udara*.
- Wang, L., Wang, Y., Chen, Y., Pan, X., Zhang, W., & Zhu, Y. (2020). Methodology For Assessing Dependencies Between Factors Influencing Airline Pilot Performance Reliability: A Case Of Taxiing Tasks. *Journal Of Air Transport Management*,, 89, 101877. Doi:10.1016/J.Jairtraman.2020.101877 . Sciencedirect.
- Xiaodong Cao , Piers Macnaughton, Leslie R. Cadet, Jose Guillermo Cedeno-Laurent, Skye Flanigan, Jose Vallarino, Deborah Donnelly-Mclay , David C. Christiani, John D. Spengler And Joseph G. Allen. (2019). Heart Rate Variability And Performance Of Commercial Airline Pilots During Flight Simulations. *Int. J. Environ. Res. Public Health* , 16, 237; Doi:10.3390/Ijerp16020237/[www.mdpi.com/Journal/Ijerp](http://www.mdpi.com/Journal/Ijerp).

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