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The Importance and Performance Levels of the Fatigue Risk Management System (FRMS) in Airline Companies: A Pilot's Perspective

Hadi Al-Shadiq Fuadin[1], Fariz Muhammad[2], Abdullah Ade Suryobuwono[3]
[1,2,3] Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia
Corresponding Author: hadi1535@gmail.com

Abstract: This study aims to assess the relevance and performance of the Fatigue Risk Management System (FRMS) from the viewpoint of pilots, focusing on its effectiveness in minimizing fatigue-related risks. Pilot fatigue is a significant safety concern in aviation, and FRMS is a structured system intended to mitigate such risks by monitoring, reporting, and implementing preventive measures. This research utilizes the Importance Performance Analysis (IPA) to evaluate FRMS implementation within airline companies. Through questionnaires and surveys, the study considers varying levels of pilot fatigue and how the FRMS addresses these variations. The findings expose several shortcomings in the execution of the system and suggest necessary improvements in managing pilot fatigue. The insights gained contribute to improving FRMS application and enhancing overall airline safety practices.
Keywords: *Pilot's Perspective, Fatigue-Related Risks, Fatigue Management, Hazard Identification, Pilot Fatigue.*

Introduction

The Fatigue Risk Management System (FRMS) plays a pivotal role in aviation, specifically designed to mitigate the risks associated with pilot fatigue. In the heavily regulated aviation sector, managing fatigue is of utmost importance to ensure that flight operations remain not only safe but also efficient. Fatigue, when not properly managed, can significantly affect a pilot's ability to perform essential duties, thereby compromising overall flight safety. The aviation industry has recognized the critical nature of this issue, and organizations such as the International Civil Aviation Organization (ICAO) have emphasized the necessity of incorporating proactive safety management measures into daily operations. According to (Doc 9859 Safety Management Manual, 2018), these measures should include the identification of hazards, effective risk mitigation practices, and the promotion of a safety-oriented culture across airline operations. Such strategies are seen as vital components for the prevention of fatigue-related accidents and incidents.

Pilot fatigue is widely acknowledged as a major safety concern in the industry. This condition can severely impair cognitive functions, leading to slower reaction times, poor decision-making, and an increased likelihood of mistakes. Multiple studies, such as those by (Powell et al., n.d.)and (Caldwell, 2012), have thoroughly examined the physiological effects of fatigue, particularly on long-haul flights. Pilots flying for extended periods, often across different time zones, experience disruptions to their circadian rhythms—their body's natural sleep-wake cycle. These disruptions can lead to severe fatigue, making it more difficult for pilots to maintain focus and make quick decisions in high-pressure situations. The link between fatigue and aviation incidents has been well-documented, underlining the critical need for an effective system like FRMS to manage and mitigate fatigue-related risks.

FRMS offers a comprehensive framework to address pilot fatigue through several key strategies, including predictive modeling, real-time fatigue monitoring, and preventive measures. Predictive modeling allows airlines to anticipate periods when pilots are most likely to be fatigued based on

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duty schedules, sleep patterns, and flight length. By monitoring fatigue levels in real-time, airlines can better assess risks as they arise and make informed decisions to adjust operations if necessary. This system serves as a powerful tool for managing fatigue, helping airlines ensure that flights remain safe by minimizing the risk of human error due to fatigue. Through real-time assessments and data-driven approaches, airlines can quickly respond to potential fatigue-related issues, thus improving overall operational efficiency.

The objective of this study is to evaluate the performance of FRMS from the perspective of pilots, who are directly affected by fatigue and the systems designed to manage it. Utilizing Importance Performance Analysis (IPA), the research aims to pinpoint the specific areas where FRMS is succeeding and where improvements are needed. By gathering feedback from pilots through structured surveys and questionnaires, the study offers an in-depth understanding of the effectiveness of FRMS across different airlines. These insights are crucial for identifying both the strengths and weaknesses of the system. Furthermore, the study provides actionable recommendations to enhance FRMS and optimize fatigue management, with the ultimate goal of improving safety and operational efficiency within the aviation industry.

In conclusion, FRMS is essential to managing pilot fatigue, a critical factor in ensuring the safety and efficiency of aviation operations. This study's findings will contribute to a deeper understanding of the system's performance, offering airlines key strategies for improvement.

Literature Review

Fatigue is universally recognized as a critical safety concern within the aviation industry, affecting pilots across both short-haul and long-haul flight operations. The nature of aviation work often exposes pilots to irregular sleep schedules, extended duty hours, and frequent disruptions to their natural sleep-wake cycles. This can severely impair their performance, reducing alertness and increasing the risk of errors. As highlighted by (Goode, 2003), fatigue has been identified as a contributing factor in approximately 20% of aviation accidents. This significant statistic demonstrates the urgent need for robust and effective systems to manage and mitigate fatigue in order to enhance safety in aviation.

The introduction of the Fatigue Risk Management System (FRMS) represents a significant advancement in addressing fatigue-related issues in aviation. Unlike traditional prescriptive duty time regulations that apply rigid, one-size-fits-all approaches to managing work schedules, FRMS provides a more adaptable framework. It uses real-time data, predictive models, and performance-based regulations to anticipate and manage fatigue among flight crew members. This flexibility allows airlines to tailor fatigue management strategies to the specific needs of individual pilots and crew members, reducing the likelihood of fatigue-related incidents. As noted by (*FMG for Airline Operators 2nd Ed (Final) EN*, n.d.) where an airline operator operates under FRMS, more effort on fatigue-specific risk assessment is expected, with particular focus on assessing the time in a duty period or pattern of work where potential fatigue impairment poses the greatest risk.

Research conducted by (Dawson & McCulloch, 2005), further underscores the importance of utilizing both proactive and reactive strategies in managing fatigue. Proactive measures, such as predictive modeling and fatigue risk assessments, can help prevent fatigue from becoming a safety issue before it manifests. On the other hand, reactive strategies, such as incident reporting and post-event analysis, allow airlines to respond to fatigue-related incidents when they do occur and refine their fatigue management practices based on these experiences. This dual approach ensures that fatigue is addressed both preventively and adaptively, enhancing the overall effectiveness of fatigue risk management systems.

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In reference to (*FMG for Airline Operators 2nd Ed (Final) EN*, n.d.), fatigue is inevitable in 24/7 operations because the human brain and body function optimally with unrestricted sleep at night. Factors such as age, lifestyle, health, and circadian rhythm preferences all influence how pilots experience fatigue. This means that any effective fatigue management system must account for these individual differences. It is not enough to simply implement broad guidelines; airlines must use personalized data to tailor fatigue management practices to each pilot's unique needs and circumstances.

Recent technological advancements have further bolstered the effectiveness of FRMS. Tools like actigraphy and polysomnography, as discussed by (Caldwell, 2012), enable real-time monitoring of pilot alertness levels, providing immediate data that can be used to intervene when necessary. These technologies offer valuable insights into how fatigue affects pilots during different phases of flight. Additionally, self-reported fatigue assessments continue to serve as useful tools for gathering subjective data on how pilots perceive their own fatigue levels.

However, despite the advancements in FRMS, there are still notable challenges. (Rosekind et al., 1994) found that many airlines struggle with effectively implementing these systems, particularly in terms of identifying fatigue-related hazards and maintaining consistent monitoring practices. Pilot feedback reveals that while the FRMS framework is solid in theory, its practical execution leaves room for improvement. To address this, (Powell et al., n.d.) proposed a fatigue assessment model that integrates both subjective and objective data, offering a more holistic understanding of how fatigue impacts pilots throughout various flight operations.

This comprehensive review of existing literature provides the basis for evaluating the current state of FRMS implementation from the pilot's perspective. In the following sections, the research methodology will be outlined, followed by an analysis of the findings gathered from pilot surveys.

Research Method

This research used a structured approach to gather data, focusing on pilot feedback regarding the Fatigue Risk Management System (FRMS). A quantitative method was applied, with 54 pilots from various airlines participating in a survey designed to measure their perspectives on the importance and effectiveness of different FRMS components. The goal was to assess how well these components are performing in real-world operations.

Survey Design:

The survey was built around ten key elements of the FRMS, identified through prior research and interviews with pilots. These elements included:

- The effectiveness of fatigue monitoring systems
- The process for identifying fatigue-related hazards
- Pilots' understanding of the FRMS policies
- Ease of access to fatigue reporting channels
- Improvement in fatigue management since the implementation of FRMS
- Quality of feedback and actions taken in response to fatigue reports
- Relevance of FRMS documentation to daily operations
- Accessibility of FRMS documentation
- Quality of FRMS training programs
- Pilot involvement in FRMS performance reviews

For each element, pilots rated both its importance (on a scale from 1 to 5, with 5 being extremely important) and its current performance (on a scale from 1 to 5, with 5 being excellent). This dual-rating system allowed for the construction of an Importance-Performance Analysis (IPA) matrix,

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which helped identify where improvements are needed and where the airlines are meeting or exceeding expectations.

Data Collection:

Pilots were invited to complete the survey through an online platform, which ensured both ease of access and anonymity. Out of 100 pilots invited, 54 responded, resulting in a response rate of 77%. The participants represented a wide range of experience levels, from junior pilots with fewer than five years of experience to senior captains with over 20 years in the industry. This diversity ensured a well-rounded assessment of the FRMS's performance.

Data Analysis:

The data was analyzed using the Importance-Performance Analysis (IPA) matrix, which categorizes the FRMS components into four areas:

- **Concentrate Here**: Components that are highly important but are underperforming.
- **Keep Up the Good Work**: Components that are important and are performing well.
- **Low Priority**: Components that are less important and are underperforming.
- **Possible Overkill**: Components that are performing well but are not viewed as highly important.

This matrix allowed for a clear understanding of the strengths and weaknesses of the FRMS from the pilots' perspective, helping to identify which areas require immediate attention and which are performing as expected.

Limitations:

While the study offers valuable insights, it is limited by the self-reported nature of the data, which could introduce bias. Additionally, the study focuses primarily on pilots' perspectives and does not take into account feedback from other stakeholders, such as airline safety managers or regulatory bodies. Future research could expand on this by including a broader range of viewpoints.

Results and Discussion

The responses from the 54 pilots were analyzed using the Importance-Performance Analysis (IPA) matrix, allowing a detailed review of the strengths and weaknesses of the FRMS from the pilots' perspectives. The results, presented in Table 1, provide the average importance and performance ratings for each attribute of the Fatigue Risk Management System (FRMS). The mean importance rating across all FRMS attributes is 3.83, calculated from individual ratings of 3.91, 3.84, 4.05, 3.87, 3.87, 3.82, 3.62, 3.67, 3.78, and 3.89. Similarly, the mean performance rating is 2.74, derived from the performance scores of 2.58, 2.55, 3.05, 2.84, 2.56, 2.65, 2.73, 2.75, 2.64, and 3.00. These average ratings help identify which FRMS attributes are viewed as most important and how effectively they are currently being implemented.

Key Findings:

1. **Fatigue Monitoring Effectiveness**

   The analysis shows that the effectiveness of fatigue monitoring is an area of concern within the Fatigue Risk Management System (FRMS). This attribute has an importance rating of 3.91, which is above the mean importance score of 3.83, indicating that it is considered highly significant by the pilots. However, its performance rating is 2.58, which falls below the mean performance score of 2.74. As a result, this attribute is positioned in the "Concentrate Here" quadrant of the IPA matrix, suggesting that it requires immediate attention and improvement to align its performance with its perceived importance.

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2. **Fatigue Hazard Identification**

   The attribute of fatigue hazard identification is critical for ensuring safety within the Fatigue Risk Management System (FRMS). It has an importance rating of 3.84, which is above the mean importance score of 3.83, reflecting its high priority among pilots. However, the performance rating for this attribute is 2.55, which is below the mean performance score of 2.74. This discrepancy places fatigue hazard identification in the "Concentrate Here" quadrant of the IPA matrix, indicating that the current systems may not be effectively capturing or addressing fatigue-related hazards and need significant improvement to meet the pilots' expectations and safety standards.

3. **Pilot Understanding of FRMS Policy**

   The attribute of pilot understanding of the FRMS policy is performing well, as indicated by its importance rating of 4.05, which is above the mean importance score of 3.83. Its performance rating is 3.05, also above the mean performance score of 2.74, placing it in the "Keep Up the Good Work" quadrant of the IPA matrix. This suggests that pilots generally have a solid understanding of the FRMS policies, which is crucial for the system's effective implementation. However, it remains important to maintain continuous efforts to ensure that pilots are consistently informed about any policy updates to sustain this positive performance.

4. **Ease of Access to Fatigue Reporting Systems**

   The ease of access to fatigue reporting systems is rated positively, with an importance score of 3.87, which is above the mean importance rating of 3.83, and a performance score of 2.84, also above the mean performance rating of 2.74. This places the attribute in the "Keep Up the Good Work" quadrant of the IPA matrix. The positive rating indicates that the accessibility of these reporting systems is meeting pilots' expectations. To maintain this favorable performance, airlines should continue focusing on ensuring that these systems remain readily accessible, allowing pilots to efficiently report any fatigue concerns.

5. **Improvements in Fatigue Management Since FRMS Implementation**

   The attribute of improvements in fatigue management since the implementation of the Fatigue Risk Management System (FRMS) holds an importance rating of 3.87, which is above the mean importance score of 3.83. However, its performance rating is 2.56, below the mean performance score of 2.74. This places it in the "Concentrate Here" quadrant of the IPA matrix. While pilots acknowledge the importance of ongoing improvements in fatigue management, the current performance levels suggest that airlines need to dedicate more effort and resources to enhancing these initiatives to better meet the pilots' expectations and ensure safety.

6. **Quality of Feedback on Fatigue Reports**

   The quality of feedback on fatigue reports has an importance rating of 3.82, which is slightly below the mean importance score of 3.83, and a performance rating of 2.65, also below the mean performance score of 2.74. This positions it in the "Low Priority" quadrant of the IPA matrix. While feedback mechanisms are recognized as important, they are considered less critical in comparison to other FRMS attributes. However, it remains beneficial for airlines to periodically review and

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improve their feedback processes to ensure they continue to function effectively and support overall fatigue management efforts.

7. **Relevance of FRMS Documentation to Daily Operations**

   The relevance of FRMS documentation to daily operations has an importance rating of 3.62, which is below the mean importance score of 3.83, and a performance rating of 2.73, just below the mean performance score of 2.74. This places it in the "Low Priority" quadrant of the IPA matrix. While FRMS documentation is necessary, it does not rank as a top priority for pilots compared to other aspects of the system. Nevertheless, it remains important for airlines to keep the documentation relevant and up to date to effectively support daily operations and maintain compliance with safety standards.

8. **Ease of Access to FRMS Documentation**

   The ease of access to FRMS documentation has an importance rating of 3.67, below the mean importance score of 3.83, and a performance rating of 2.75, just above the mean performance score of 2.74. This places it in the "Possible Overkill" quadrant of the IPA matrix. While pilots find the documentation easily accessible, they do not view this as a critical issue. This suggests that the resources currently dedicated to ensuring easy access to documentation could potentially be reallocated to more critical areas, such as improving fatigue monitoring, where greater attention and investment may be needed.

9. **FRMS Training Program Quality and Effectiveness**

   The quality and effectiveness of the FRMS training program has an importance rating of 3.78, slightly below the mean importance score of 3.83, and a performance rating of 2.64, which is also below the mean performance score of 2.74. This positions it in the "Low Priority" quadrant of the IPA matrix. While training programs are essential for ensuring that pilots understand and correctly apply the FRMS, pilots currently perceive this area as less important compared to other attributes. However, it remains important for airlines to periodically assess and update the effectiveness of their training programs to ensure they continue to meet operational and safety needs.

10. **Involvement of Pilots in FRMS Performance Reviews**

    The involvement of pilots in FRMS performance reviews has an importance rating of 3.89, which is above the mean importance score of 3.83, and a performance rating of 3.00, also above the mean performance score of 2.74. This places it in the "Keep Up the Good Work" quadrant of the IPA matrix. Pilots value their involvement in the review process, and this area is performing well. To maintain this positive momentum, airlines should continue involving pilots in FRMS performance reviews to ensure ongoing improvements and foster collaboration in fatigue risk management efforts.

Discussion:

The Importance-Performance Analysis (IPA) matrix provides valuable insights into how pilots perceive the effectiveness of various components of the Fatigue Risk Management System (FRMS). The matrix highlights several areas where airlines should focus their efforts to ensure that fatigue is adequately managed, particularly in high-risk situations. Among the most critical components identified by pilots are fatigue monitoring and hazard identification, which are seen

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as essential aspects of the FRMS. Despite their recognized importance, these areas are currently underperforming, posing a significant challenge to airline safety.

Fatigue monitoring is a crucial element in preventing fatigue-related incidents, as it allows airlines to assess pilots' fatigue levels in real-time. By monitoring fatigue throughout different stages of flight, airlines can make informed decisions about whether pilots are fit to continue operating or require rest. When fatigue monitoring is inadequate, it increases the likelihood of pilot errors, which can lead to serious safety concerns. Hazard identification is similarly vital, as it helps airlines detect potential risks before they escalate into critical issues. Without proper systems in place to identify hazards, airlines may overlook key indicators of fatigue, increasing the risk of fatigue-related incidents. Therefore, enhancing these two components is essential to improving overall flight safety. Addressing these gaps must become a top priority for airlines, as neglecting them could result in a higher risk of incidents caused by pilot fatigue.

On the other hand, several areas of the FRMS are performing well, according to pilots. One such area is pilot understanding of FRMS policies. Ensuring that pilots are well-informed about the policies in place to manage fatigue is crucial for successful implementation. If pilots are aware of the guidelines, procedures, and safety measures, they are more likely to comply with them and contribute to a safer operating environment. Similarly, the ease of access to fatigue reporting systems is seen as a strong point in the current FRMS framework. Pilots are able to report their fatigue concerns without difficulty, which is key to addressing and mitigating risks in a timely manner. Maintaining these strengths is important to ensure that pilots remain engaged in the fatigue management process and feel comfortable raising concerns whenever necessary. Ensuring that pilots can easily access reporting systems will allow airlines to gather valuable data on fatigue trends and take appropriate action.

In contrast, other attributes, such as FRMS documentation and feedback mechanisms, are considered to be of lower importance by pilots. These components are not seen as critical to daily operations and do not require the same level of focus as fatigue monitoring or hazard identification. FRMS documentation involves keeping records and policies up to date, which is important but not necessarily a priority in the day-to-day management of fatigue. Similarly, feedback mechanisms, while useful, are considered less urgent in ensuring pilot safety. Pilots are more concerned with practical solutions, like effective fatigue monitoring, rather than the processes that follow after an issue has already been reported.

The lower priority placed on these attributes suggests that airlines might consider reallocating resources to focus on areas that directly impact fatigue risk, such as improving monitoring systems and hazard identification procedures. By directing attention and resources to the critical aspects of fatigue management, airlines can better safeguard flight operations and reduce the overall risk of fatigue-related incidents. The key to effective fatigue risk management lies in addressing the most pressing concerns while maintaining a balanced approach to other aspects of the system that contribute to its overall effectiveness.

Conclusion

This research provides a comprehensive analysis of the Fatigue Risk Management System (FRMS) from the perspective of pilots, highlighting both its strengths and areas needing improvement. While the system has shown considerable promise in various aspects, particularly in terms of policy comprehension and ease of access to reporting mechanisms, it is evident that certain critical elements are underperforming. These gaps need to be addressed to ensure that the FRMS can fully

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serve its intended purpose—safeguarding pilots and overall flight operations from the risks associated with fatigue.

One of the primary concerns identified by pilots through the Importance-Performance Analysis (IPA) matrix is the effectiveness of fatigue monitoring and the process of identifying fatigue-related hazards. These two components are integral to ensuring flight safety, yet they are currently not meeting expectations. Fatigue monitoring is essential for assessing real-time levels of pilot alertness, enabling airlines to make informed decisions about whether a pilot is fit to continue with their duties. Similarly, hazard identification is vital for preemptively detecting risks related to fatigue, thereby preventing incidents before they can occur. Pilots' feedback suggests that these areas are not being managed as effectively as they could be, which could compromise overall safety if not improved.

While these gaps are significant, the research also uncovers areas where FRMS is performing well. Pilots have a strong understanding of the policies governing fatigue management, a factor that plays a critical role in ensuring compliance and effectiveness. Pilots must be aware of the guidelines and procedures in place so that they can follow them and engage in the system in a meaningful way. The study found that this aspect of FRMS is functioning well across airlines. Similarly, the ease of access to fatigue reporting systems is another area where FRMS excels. Pilots appreciate having straightforward and efficient ways to report their fatigue concerns, which ensures that issues can be addressed promptly. These strengths should not only be maintained but potentially enhanced to ensure pilots feel consistently supported and empowered to report fatigue.

However, despite these positive aspects, the study underscores that airlines must focus more attention on improving their fatigue hazard identification and monitoring processes. Simply having policies and reporting systems in place is not enough. The effectiveness of FRMS depends on its ability to actively identify and address fatigue risks before they become safety threats. Not having an effective FRMS in place leaves airlines vulnerable to the real dangers of pilot fatigue—slower reactions, mistakes, and ultimately, a greater risk of accidents. Without this system, pilots face the pressures of long hours and disrupted sleep schedules without the support they need to stay alert and sharp. Airlines need to adopt a more proactive approach, investing in technologies and strategies that can better monitor and detect fatigue-related hazards.

In conclusion, while the Fatigue Risk Management System is undoubtedly a valuable tool in reducing the risks posed by pilot fatigue, there is considerable room for improvement. Airlines must take proactive steps to address the gaps in monitoring and hazard identification to ensure that the system performs at its full potential. Doing so will not only enhance flight safety but also contribute to better pilot well-being, creating a safer and more efficient aviation environment overall.

Implications

The findings of this study have far-reaching implications for both airline management and aviation regulatory bodies, underscoring the importance of addressing key areas related to fatigue management. For airline management, the study highlights the critical need to continuously improve fatigue monitoring systems and the processes for identifying fatigue-related hazards. By addressing these gaps, airlines can better manage the risks associated with pilot fatigue, which will not only enhance pilot performance but also significantly improve overall flight safety. Pilots' well-being and their ability to perform at their best are directly linked to how effectively airlines manage and mitigate the risks of fatigue.

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From a regulatory perspective, the study offers valuable insights for organizations such as the International Civil Aviation Organization (ICAO) and the Federal Aviation Administration (FAA). These organizations are in a position to reassess and update their current fatigue management regulations in light of the study's findings. The research advocates for a shift toward a more performance-based approach to fatigue management, which would give airlines the flexibility to tailor their strategies according to the specific needs of their pilots and operational contexts. A one-size-fits-all model is not effective when it comes to fatigue risk, and allowing for more tailored approaches will ensure that fatigue is managed more proactively and effectively across the industry.

On the academic front, this study makes a meaningful contribution to the ongoing discourse on fatigue risk management. By offering a detailed evaluation of FRMS from the pilots' perspective, it provides an essential viewpoint that can serve as a foundation for future research. However, to gain a more comprehensive understanding of FRMS effectiveness, future studies should incorporate the perspectives of other key stakeholders, including safety managers, ground staff, and regulatory officials. Expanding the scope of research to include these voices will help create a more holistic view of how well FRMS is functioning and what further improvements can be made.

Ultimately, the insights from this study can serve as a roadmap for both airlines and regulatory bodies to make informed decisions that will enhance the overall effectiveness of fatigue management systems in aviation.

Research Limitations

While this study provides valuable insights into how pilots view the Fatigue Risk Management System (FRMS), several limitations need to be taken into account when interpreting the findings. First, the study relies heavily on self-reported data from pilots, which may introduce an element of bias. Pilots' individual experiences, perceptions, and personal views could influence their responses, making the data somewhat subjective. This reliance on personal accounts means that the results might not be entirely objective, which poses challenges in generalizing the findings to the broader aviation industry. Each airline and region may have varying operational conditions and fatigue management practices, making it difficult to apply these findings universally.

Moreover, this study focuses primarily on the perspective of pilots, without considering the feedback and experiences of other critical stakeholders such as airline safety managers, maintenance teams, and regulatory bodies. These stakeholders play essential roles in the overall effectiveness of FRMS implementation. For instance, safety managers oversee the integration of fatigue management practices, and maintenance teams handle operational aspects that might influence pilot fatigue, while regulatory bodies provide the legal framework within which these systems operate. Incorporating insights from these groups could offer a more holistic view of how well FRMS functions within the broader airline ecosystem, revealing opportunities for further refinement and improvement.

Another limitation of the study is its sample size, which includes responses from 54 pilots. While this group is representative, the relatively small sample may not capture the full diversity of experiences across the aviation industry. Different airlines, regions, and flight operations can yield varying levels of fatigue risk, and expanding the sample size to include a broader range of pilots from various airlines and geographic locations could offer a more robust evaluation of FRMS effectiveness.

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Lastly, the study primarily focuses on airlines that operate under specific regulatory frameworks. Regulatory bodies, such as the FAA in the United States and the EASA in Europe, each have different rules and standards for fatigue management, which can influence how FRMS is implemented. Future research could delve deeper into how these regional differences affect the success of fatigue management practices and what lessons can be learned from diverse regulator environments to enhance FRMS globally.

Tables and Figures

Table 1 below summarizes the results of the Importance-Performance Analysis (IPA) for various FRMS attributes, based on the feedback provided by the participating pilots.

Attribute	Importance	Performance	Quadrant
Effectiveness of fatigue monitoring	3.91	2.58	Concentrate Here
Process of identifying fatigue-related hazards	3.84	2.55	Concentrate Here
Pilot understanding of FRMS policy	4.05	3.05	Keep Up the Good Work
Ease of access to fatigue reporting systems	3.87	2.84	Keep Up the Good Work
Improvement in fatigue management since FRMS implementation	3.87	2.56	Concentrate Here
Quality of feedback and actions taken	3.82	2.65	Low Priority
Relevance of FRMS documentation	3.62	2.73	Low Priority
Ease of access to FRMS documentation	3.67	2.75	Possible Overkill
Quality of FRMS training programs	3.78	2.64	Low Priority
Involvement of pilots in FRMS reviews	3.89	3.00	Keep Up the Good Work

This table categorizes the FRMS components into four quadrants:

- **Concentrate Here**: Elements that are highly important but currently underperforming, requiring immediate attention from airlines.
- **Keep Up the Good Work**: Areas that are both important and well-executed, indicating that no major changes are necessary.
- **Low Priority**: Aspects that are less important and also underperforming, suggesting they don't require urgent improvement.
- **Possible Overkill**: Attributes that perform well but are not as crucial, potentially allowing airlines to reallocate resources to more critical areas.

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