International Journal of Multidisciplinary Research and Growth Evaluation.

Enhancing Aviation Safety: Addressing Operational Challenges with Technologies in a Major International Airport Terminal 1 in the Philippines

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Article Info

Abstract
This study aims to identify and address gaps and challenges in Terminal 1 by enhancing aviation safety through technological modernization. The research addresses significant issues that may affect the integrity and safety of passengers and airport personnel. Key problems include passenger flow management, security screening procedures, technology integration, and training and preparedness response. The study also examines respondents' perceptions of existing technology in the airport terminal and how these technologies impact their sense of safety. Feedback from professional informants and respondents is incorporated to provide recommendations and general perceptions of the airport. A mixed-methods approach was used, including surveys to gather data from selected respondents. Data collection involved a satisfaction scaling technique to assess the gaps in key issues and current perceptions of technology in selected airport terminals. The results indicate respondents are generally unsatisfied with current technology, citing outdated facilities and equipment as key concerns. The study suggests upgrading to world-class standards and improving personnel training programs could significantly enhance safety and reduce the risk of accidents and incidents. The findings highlight the need for airport administration to implement changes and updates to keep pace with technological advancements and provide a strategic program that enhances and improves aviation safety at the airport.

1. Introduction
The present study seeks to evaluate and address pressing safety and operational inefficiencies in a high-traffic airport terminal, enhancing aviation safety through modern technology, efficient passenger flow management, improved security screening, and strengthened personnel training. Although existing studies have explored individual aspects of airport safety, such as advanced surveillance systems (Okine *et al.*, 2024) [20], checkpoint efficiency (Knol *et al.*, 2019) [13], and passenger perceptions (Güres *et al.*, 2017) [7], there remains a lack of integrated research that simultaneously considers technological modernization, staff competency, and passenger experience in a single airport context. Previous studies often isolate either operational improvements or user perception without connecting them to safety performance outcomes. Moreover, few have assessed these factors within the specific setting of NAIA Terminal 1, where outdated systems and rising passenger volumes exacerbate existing inefficiencies (Gumasing *et al.*, 2020) [6]. This study fills that gap by providing a holistic assessment, grounded in both qualitative and quantitative data, to inform evidence-based safety enhancements.

2. Methods
The study used a mixed-methods approach to explore the impact of technology modernization on aviation safety at Airport Terminal 1. It began with an explanatory approach, collecting quantitative data, followed by qualitative insights. A phenomenological approach was also used to understand individual perceptions of safety implementation.

Data were collected through surveys, questionnaires, and one-on-one interviews. Samples were selected using simple random and convenience methods for diverse representation. In-depth interviews were conducted to explain trends and gaps identified in the survey. Cross-tabulation and thematic analysis were used to identify key patterns and relationships related to the impact of technology on aviation safety.

2.1. Respondents
This study employed Slovin's formula to determine a random sample of 400 passengers and airport personnel from the selected airport site for the quantitative analysis. The primary objective was to gather demographic data such as age, sex, and airport preferences from the respondents. Additionally, specific questions were posed to passengers and airport personnel: for passengers, the frequency and purpose of travel were assessed

Table 1: Frequency and Distribution of the Age Bracket of the Respondents

Age	Frequency	Percent
18 - 25	85	52.50
26 - 33	40	24.70
34 - 40	20	12.30
41 and above	17	10.50
Total	162	100.00

Table 1 indicates that the majority of respondents, comprising passengers and airport personnel, fall within the 18–25 age range, representing 52.50% of the sample. This suggests that most respondents are part of a younger demographic group.

Table 2: Frequency, Percentage, and Distribution of the Sex Representation of the Respondents

Sex	Frequency	Percent
Male	87	53.70
Female	75	46.3
Total	162	100.00

Table 2 shows that the majority of respondents, based on their sex, are male, accounting for 63.55% of the sample.

Table 3: Frequency, Percentage, and Distribution of the Role Profile Representation of the Respondents

Role	Frequency	Percent
Passenger	131	80.90
Airport Personnel	31	19.10
Total	162	100.00

Table 3 Based on a total of 162 responses, 131 were from passengers, accounting for 80.90%, while only 31 were from airport personnel (19.10%). Researchers equally divide the response for passenger and airport personnel.

Table 4: Frequency, Percentage, and Distribution Based on Frequency of Air Travel

Frequency of Travel	Frequency	Percent
First time	28	17.30
Rarely (2 to 3 times a year)	82	50.60
Occasionally (4 to 5 times a year)	15	9.30
Frequently (6 or more times a year)	6	4.60
Total	131	80.80

Table 4 presents the demographic details regarding the frequency of air travel among respondents as passengers. The results indicate that most respondents travel infrequently, with a frequency of 2 to 3 times per year.

Table 5: Frequency, Percentage, and Distribution Based on Purpose of Air Travel

Purpose of Travel	Frequency	Percent
Leisure	106	65.40
Business	11	6.80
Educational	12	7.4
Official Government	2	1.20
Medical Health Reason	0	0.00
Total	131	80.80

Table 5 data shows that education has a respondents of 12 with a (7.4%) "Official Government" having 2 respondents with (1.20%) and "Medical Health" have zero respondents. And having a missing 31 with a percentage of 19.20%.

Table 6: Frequency, Percentage, and Distribution Based on Airport Personnel Position

Personnel Position	Frequency	Percent
Administrative/Management	0	0.00
Security Personnel	4	2.50
Ground Staff	13	8.00
Maintenance Staff	5	3.10
Technical Staff	9	5.60
Air Traffic Controller	0	0.00
Total	31	19.20

Table 6 "Ground Staff" accounts for the biggest percentage of respondents (8,00%). Technical Staff" comes in second at (5.60%), and 'maintenance' staff have 5 respondents, having a percentage of (3.10%), and also the 'security personnel' have 4 respondents (2.50%). while "Administrative/ Management" and "Air Traffic Controller" receive zero responses. The response distribution is apparent, indicating where the most and least frequent responses occurred.

Table 7: Frequency, Percentage, and Distribution Based on Length of Employment

Length of Employment	Frequency	Percent
3-8 months	19	11.70
1-3 years	12	7.40
4-7 years	0	0.00
8-10 years	0	0.00
Over 10 years	0	0.00
Total	31	19.10

Table 7 shows that most respondents (11.70%) have less than one year of work experience, followed by 7.40% with 1–3 years. For the qualitative part, three key informants with experience as both passengers and airport personnel were selected to provide insights into existing gaps and suggest improvements at the airport.

2.3 Settings
The study examined perceptions of safety, service efficiency, and operational issues related to technological modernization in aviation. Using a mixed-method approach, it aimed to identify gaps and propose improvements to enhance safety and the passenger experience. Research was conducted at a busy international terminal, involving passengers aged 18+

and airport staff with at least three months of experience. Data was gathered through surveys, questionnaires, and interviews, using simple random and convenience sampling. Thematic analysis of the responses highlighted key themes on how modern technology influences aviation safety.

2.4. Instrumentation
The researchers used a combination of questionnaires and interviews to examine the impact of technological modernization and emergency backup systems on aviation safety, focusing on four key areas: Technology Integration, Training and Preparedness Response, Passenger Flow Management, and Security Screening Procedures. The survey underwent a thorough review by academic and industry professionals and was refined through a pilot test with students. The final version aimed to assess how technology can enhance airport operations. Interviews with three informants provided professional insights into challenges with current systems. The combined data supported the study's objectives.

2.5. Data Analysis
The research identifies gaps between an organization's current and desired states, using a thematic approach to guide analysis. Slovin's formula determines the survey sample size, while t-tests and ANOVA assess statistical differences

between groups. Qualitative data from interviews is analyzed for patterns and themes. Frequency analysis identifies response trends, and weighted means highlight key factors based on response significance.

Table 8: Range of Scales

Scale	Range	Adjectival Interpretation
4	3.51-4.00	Strongly Agree
3	2.51-3.50	Agree
2	1.51-2.50	Disagree
1	1.00-1.50	Strongly Disagree

2.6. Ethical Considerations
This research ensured the safety, privacy, and voluntary participation of all respondents. Data was kept confidential, and all procedures followed ethical guidelines. The questionnaire and problem statement were validated by professionals through formal approval, with revisions made based on their feedback. A pilot test with aviation students and experienced individuals helped refine the survey. For the actual study, institutional permissions and airport protocol compliance were secured, and participants gave informed consent. Surveys were conducted respectfully in comfortable settings, with efforts made to avoid inconvenience and maintain respondent anonymity.

3. Results and Discussion
3.1. The technological gaps in regards to aviation safety in the airport terminal 1 concerning the following factors:
3.1.1 Passenger Flow Management

Table 9: Mean and Standard Deviation in Terms of Passenger Flow Management

Statement	Standard Deviation	Weighted Mean	Decision
The terminal manages passenger congestion well during busy times.	0.75158	2.35	Disagree
The terminal layout allows passengers to move easily.	0.69750	2.34	Disagree
The facilities at the terminal are enough to handle large numbers of passengers.	0.74882	2.20	Disagree
The main entrance of the terminal has no long lines because of passports and boarding passes.	0.77268	2.27	Disagree

Legend: 3.51 - 4.00 - Strongly Agree 2.51 - 3.50 - Agree 1.51 - 2.50 - Disagree 1.00 - 1.50 - Strongly Disagree

This section presents data on passenger experience at the terminal, highlighting issues with congestion management, terminal layout, facility sufficiency, and entrance efficiency. The standard deviation ranged from 0.69750 to 0.77268, showing varied responses. A weighted mean of 2.29 indicates general dissatisfaction, with most respondents disagreeing on all aspects. The findings suggest poor handling of high passenger volumes, reinforcing the need for improved infrastructure and staff training, as supported by previous studies.

3.1.2 Security Screening Procedure

Table 10: Mean and Standard Deviation in Terms of Security Screening Procedures

Statement	Standard Deviation	Weighted Mean	Decision
The security checks at the terminal for passengers are fast, making sure there are no extra delays.	0.80869	2.41	Disagree
The immigration and check-in counters at the terminal are always available, which is why there are no long lines for passengers.	0.80705	2.21	Disagree
Leaving personal belongings at the terminal is secure and will not lead to confusion when claiming them later.	0.90303	2.41	Disagree

This section assesses passenger experiences related to security checks, immigration and check-in counter availability, and the security of personal belongings. Standard deviations ranged from 0.80705 to 0.90303, indicating varied opinions. The weighted mean of 2.34 falls under "Disagree," reflecting dissatisfaction with long lines, delays, and concerns over item security. These findings align with previous studies emphasizing the importance of efficient security procedures and skilled personnel in enhancing passenger satisfaction and flow.

3.1.3 Technology Integration

Table 11: Mean and Standard Deviation in Terms of Technology Integration

Statement	Standard Deviation	Weighted Mean	Decision
The technology systems at the terminal are completely up-to-date and do not require any modernization to ensure smooth operations.	0.87445	2.26	Disagree
The passenger data is safe from cyber threats at the terminal.	0.87856	2.38	Disagree
The baggage handling at the terminal has had no significant issues.	0.82111	2.23	Disagree

Legend: 3.51 - 4.00 - Strongly Agree 2.51 - 3.50 - Agree 1.51 - 2.50 - Disagree 1.00 1.50 - Strongly Disagree

This section evaluates the effectiveness of technological infrastructure, focusing on system adequacy, cybersecurity, and baggage handling. Standard deviations ranged from 0.82111 to 0.87856, reflecting varied responses, while a weighted mean of 2.29 indicates general disagreement and concern over current technology reliability and security. The findings highlight vulnerabilities in cybersecurity and system efficiency, suggesting a need for improved safeguards. Prior studies, such as those by Lykou *et al*. (2019) [15] and Dixit & Jakhar (2021) [5], support the need for enhanced technology and security protocols in airport operations.

3.1.4. Training & Preparation Response

Table 12: Mean and Standard Deviation in Terms of Training & Preparation Response

Statement	Standard Deviation	Weighted Mean	Decision
The training programs for airport staff at the terminal are already highly effective, so no further improvements are needed.	0.73319	2.23	Disagree
All employees at the terminal have a positive attitude when dealing with unruly passenger behavior.	0.85470	2.57	Agree
Airport staff at the terminal are well prepared with alternative or backup plans for operational disruptions caused by technological failures.	0.77664	2.41	Disagree

Legend: 3.51 - 4.00 - Strongly Agree 2.51 - 3.50 - Agree 1.51 - 2.50 - Disagree 1.00 1.50 - Strongly Disagree

This section evaluates staff training, attitude during difficult situations, and preparedness for disruptions. Standard deviations range from 0.73319 to 0.85470, showing varied perceptions. The weighted mean of 2.40 indicates mixed responses—while staff are seen as having a positive attitude, concerns remain about inadequate training and lack of readiness for tech disruptions. Supporting research highlights the need for improved training programs to enhance staff competency and operational preparedness.

3.2. The respondents' perceptions of the current technological measures in place for aviation safety at the airport terminal?

3.2.1 Passenger

Table 13: Mean and Standard Deviation in Terms of Passenger

Statement	Standard Deviation	Weighted Mean	Decision
The current aviation safety technologies at Major Philippine International Airport Terminal exceed my expectations for security.	0.82796	2.32	Disagree
The management of Major Philippine International Airport Terminal consistently prioritizes passenger safety in their operations.	0.88787	2.69	Agree
The Major Philippine International Airport Terminal is highly recommended for its effective aviation safety measures in today's environment.	0.86211	2.43	Disagree
The safety measures at Major Philippine International Airport Terminal are sufficient to effectively prevent security incidents.	0.84171	2.59	Agree
The Major Philippine International Airport Terminal responds promptly to potential security threats and emergencies.	0.88925	2.56	Agree
Safety announcements and emergency plans at Major Philippine International Airport Terminal are always clear and easy for passengers to understand, even when the airport is busy.	0.88262	2.51	Agree
There are no recent safety issues that need better communication at Major Philippine International Airport Terminal.	0.85604	2.38	Disagree

This section evaluates the perception of aviation safety and security, focusing on safety technologies, management's emphasis on passenger security, emergency responsiveness, and the clarity of safety communications. The responses show standard deviations ranging from 0.82796 to 0.88925, indicating variation in passenger perceptions on the effectiveness of safety protocols and communication. The weighted mean across these statements is 2.50. Respondents disagree that management prioritizes passenger safety. This suggests that current safety management and communication strategies may not be fully aligned with passenger expectations. Research by Güres *et al*. (2017) [7] and Maliwat (2018) highlights passengers' perceptions of security services, noting that while some passengers feel secure,

others express dissatisfaction with the protocols in place, pointing to a need for improved safety management and

communication to enhance overall passenger confidence and experience.

3.2.2 Personnel

Table 14: Mean and Standard Deviation in Terms of Personnel

Statement	Standard Deviation	Weighted Mean	Decision
The current aviation safety technologies at Major Philippine International Airport Terminal exceed my expectations for security.	0.36890	2.16	Disagree
The management of Major Philippine International Airport Terminal consistently prioritizes passenger safety in their operations.	0.56796	2.50	Disagree
The Major Philippine International Airport Terminal is highly recommended for its effective aviation safety measures in today's environment.	0.46555	2.09	Disagree
The safety measures at Major Philippine International Airport Terminal are sufficient to effectively prevent security incidents.	0.60158	2.34	Disagree
The Major Philippine International Airport Terminal responds promptly to potential security threats and emergencies.	0.50701	2.53	Disagree
The existing safety protocols at the airport truly prioritize the staff's well-being.	0.53506	2.19	Disagree
The training programs are not required because the airport environment is already completely safe.	0.55358	2.13	Disagree
The airport management actively seeks and values staff input on improving safety measures.	0.58112	2.28	Disagree

Legend: 3.51 - 4.00 - Strongly Agree 2.51 - 3.50 - Agree 1.51 - 2.50 - Disagree 1.00- 1.50 - Strongly Disagree

This section examines personnel perceptions of aviation safety, focusing on safety measures, training, and practices. With standard deviations ranging from 0.36890 to 0.60158, responses show varied agreement on safety aspects. The weighted mean of 2.28 indicates that personnel are dissatisfied with current safety measures, citing gaps in training, safety practices, and technological updates. Supporting studies stress the importance of improved training and continuous enhancement of safety protocols to ensure better preparedness and response to security threats.

3.3. The significant difference in the respondents' assessment of the current implemented technology concerning aviation safety at the Major Philippine International Airport Terminal

3.3.1. Significant Difference in the Respondents' Views as a Passenger in technological gaps in regards to aviation safety at Major Philippine International Airport Based on their Age

Table 15: Difference in the Respondents' views technological gaps in regards to the aviation safety at Major Philippine International Airport Based on their Frequency of Age

Statement	Age	Mean	SD	F	Sig.	Decision
The main entrance of Major Philippine International Airport Terminal has no long lines because passports and boarding passes are checked quickly, with enough staff at the door.	18-25	1.00	0.19	4.	0.0	Significant
	34-40	0.85	0.22	84	1	
The security checks at Major Philippine International Airport Terminal for 1s are fast, making sure there are no extra delays.	18-25	2.68	1.06	3.	0.5	Accept
	26-33	2.48	0.77	95	8	
The employees at Major Philippine International Airport Terminal have a positive attitude when dealing with unruly passenger behavior.	18-25	2.68	0.77	4.5	0.01	Significant
	26-33	2.73	0.82	3		

Legend:
↓ 0. 05 is significant difference/relation - Reject
↑ 0. 05 is no significant difference/relation - Accept
↓ 0. 01 - very significant

This table examines perceptions of aviation safety across different age groups. The standard deviations show varying levels of agreement within each group, with younger and older respondents displaying more variability than middle-aged ones. The weighted mean scores indicate that younger passengers (18-25) tend to perceive safety more negatively (2.10), while middle-aged respondents (34-40) show more favorable views (1.74). These differences suggest that younger travelers may have higher expectations for safety, leading to more critical perceptions, while middle-aged passengers often hold more positive views due to varying priorities and experiences.

3.3.2 Significant Difference in the Respondents' Views as Passengers in Technological Gaps in regards to Aviation Safety at Major Philippine International Airport Based on Their Gender
3.3.2.1 Passenger

Table 16: Difference in the Respondents' views on technological gaps in regards to aviation safety at Major Philippine International Airport based on their Gender

Statement	Sex	Mean	SD	F	Sig.	Decision
The current aviation safety technologies at Major Philippine International Airport Terminal exceed my expectations for security.	Male	2.39	0.78	0.85	0.35	Accept
	Female	2.25	0.88			
The management of Major Philippine International Airport Terminal consistently prioritizes passenger safety in their operations.	Male	2.69	0.86	0.01	0.94	Accept
	Female	2.70	0.93			
The Major Philippine International Airport Terminal is highly recommended for its effective aviation safety measures in today's environment.	Male	2.46	0.84	0.19	0.66	Accept
	Female	2.39	0.89			
The safety measures at Major Philippine International Airport Terminal are sufficient to effectively prevent security incidents.	Male	2.66	0.81	0.8	0.137	Accept
	Female	2.52	0.88			
Major Philippine International Airport Terminal responds promptly to potential security threats and emergencies.	Male	2.59	0.92	0.2	0.64	Accept
	Female	2.52	0.86			
Safety announcements and emergency plans at Major Philippine International Airport Terminal are always clear and easy for passengers to understand, even when the airport is busy.	Male	2.57	0.84	0.63	0.43	Accept
	Female	2.44	0.93			
There are no recent safety issues that need better communication at Major Philippine International Airport Terminal.	Male	2.45	0.82	0.95	0.33	Accept
	Female	2.30	0.89			

Legend:
↓ 0. 05 is significant difference/relation - Reject
↑ 0. 05 is no significant difference/relation - Accept
↓ 0. 01 - very significant

Table 17: Difference in the Respondents' views technological gaps in regards to the aviation safety at Major Philippine International Airport Based on their Gender

Statement	Sex	Mean	SD	F	Sig.	Decision
The current aviation safety technologies at Major Philippine International Airport Terminal exceed my expectations for security.	Male	2.25	0.44	3.75	0.06	Accept
	Female	2.00	0.00			
The Major Philippine International Airport Terminal is highly recommended for its effective aviation safety measures in today's environment.	Male	2.15	0.59	0.77	0.38	Accept
	Female	2.00	0.00			
The safety measures at Major Philippine International Airport Terminal are sufficient to effectively prevent security incidents.	Male	2.45	0.60	0.70	0.20	Accept
	Female	2.17	0.58			
Major Philippine International Airport Terminal responds promptly to potential security threats and emergencies.	Male	2.65	0.49	3.13	0.08	Accept
	Female	2.33	0.49			
The existing safety protocols at the airport truly prioritize the staff's well-being.	Male	2.25	0.55	0.72	0.40	Accept
	Female	2.08	0.51			
The training programs are not required because the airport environment is already completely safe.	Male	2.15	0.67	0.11	0.74	Accept
	Female	2.08	0.29			
The airport management actively seeks and values staff input on improving safety measures.	Male	2.30	0.66	0.05	0.81	Accept
	Female	2.25	0.45			

Legend:
↓ 0. 05 is significant difference/relation - Reject
↑ 0. 05 is no significant difference/relation - Accept
↓ 0. 01 - very significant

This table analyzes passenger perceptions of aviation safety by sex, showing that both male and female passengers have similar views, with a slightly higher weighted mean for males (2.5437) compared to females (2.4694). The standard deviations indicate that female responses are more consistent, while male responses show greater variability. Overall, the minimal differences suggest comparable perceptions of safety between the two groups, with females focusing more on overall service satisfaction and males demonstrating more variability in expectations. Both groups emphasize the importance of maintaining consistent safety standards.

3.3.2.2. Airport Personnel
This table evaluates perceptions of aviation safety based on sex among airport personnel. Male personnel show more variability in their responses, with standard deviations ranging from 0.44 to 0.67, while female personnel have a narrower range of 0.00 to 0.58. The weighted mean for male personnel is 2.36, slightly higher than the 2.15 for female personnel. The results indicate that male personnel have more critical views and greater variability, while female personnel tend to have more positive and consistent perceptions of safety. This suggests that improving safety and service based on these demographic differences could enhance overall satisfaction.

3.3.3. Significant Difference in the Respondents' Views as Passengers in Technological Gaps in regards to aviation safety at Major Philippine International Airport Based on their Frequency of Travel

Table 18: Difference in the Respondents' views technological gaps in regards to the aviation safety at Major Philippine International Airport Based on their Frequency of Travel

Statement	Frequency of Travel	Mean	SD	F	Sig.	Decision
The current aviation safety technologies at Major Philippine International Airport Terminal exceed my expectations for security	Rarely (2 to 3 times a year)	2.33	0.77	0.82	0.48	Accept
	Occasionally (4 to 5 times a year)	2.07	0.80			
The management of Major Philippine International Airport Terminal consistently prioritizes passenger safety in their operations.	Rarely (2 to 3 times a year)	2.78	0.82	1.33	0.26	Accept
	Occasionally (4 to 5 times a year)	2.40	0.83			
The Major Philippine International Airport Terminal is highly recommended for its effective aviation safety measures in today's environment.	First time	2.43	0.84	1.57	0.19	Accept
	Occasionally (4 to 5 times a year)	2.00	0.93			
The safety measures at Major Philippine International Airport Terminal are sufficient to effectively prevent security incidents.	First time	2.64	1.00	1.54	0.20	Accept
	Rarely (2 to 3 times a year)	2.67	0.76			
Major Philippine International Airport Terminal responds promptly to potential security threats and emergencies.	First time	2.60	0.99	0.21	0.89	Accept
	Rarely (2 to 3 times a year)	2.58	0.82			
There are no recent safety issues that need better communication at Major Philippine International Airport Terminal.	First time	2.42	0.92	0.47	0.70	Accept
	Rarely (2 to 3 times a year)	2.41	0.82			

Legend:
↓ 0. 05 is significant difference/relation - Reject
↑ 0. 05 is no significant difference/relation - Accept
↓ 0. 01 - very significant

This table evaluates perceptions of aviation safety based on passengers' travel frequency. First-time and rarely traveling passengers show the highest variability in their responses, with standard deviations ranging from 0.76 to 1.37 and weighted means of 2.46 and 2.55, respectively. Occasional and frequent passengers, with standard deviations ranging from 0.73 to 0.93, have more consistent perceptions, reflected in slightly lower weighted means of 2.38 and 2.38. The analysis suggests that less frequent travelers exhibit more variability in their perceptions, while more frequent travelers have more consistent views due to greater familiarity with safety protocols. This highlights how travel frequency can influence passenger perceptions of safety and service quality (Lee & Yu, 2018; Munoz *et al.*, 2019) [14, 18].

Table 19: Difference in the Respondents' views technological gaps in regards to the aviation safety at Major Philippine International Airport Based on their Frequency of Air Travel

Statement	Purpose of Travel	Mean	SD	F	Sig	Decision
The current aviation safety technologies at Major Philippine International Airport Terminal exceed my expectations for security.	Leisure	2.27	0.83	1.78	0.15	Accept
	Business	2.20	0.63			
The management of Major Philippine International Airport Terminal consistently prioritizes passenger safety in their operations.	Leisure	2.69	0.90	0.87	0.46	Accept
	Official Gov`t	2.50	0.71			
The Major Philippine International Airport Terminal is highly recommended for its effective aviation safety measures in today's environment.	Leisure	2.40	0.87	1.59	0.20	Accept
	Business	2.20	0.79			
The safety measures at Major Philippine International Airport Terminal are sufficient to effectively prevent security incidents.	Leisure	2.56	0.83	1.63	0.19	Accept
	Business	2.40	0.84			
Major Philippine International Airport Terminal responds promptly to potential security threats and emergencies.	Leisure	2.53	0.89	1.14	0.34	Accept
	Business	2.40	0.97			
Safety announcements and emergency plans at Major Philippine International Airport Terminal are always clear and easy for passengers to understand, even when the airport is busy.	Leisure	2.49	0.84	1.29	0.28	Accept
	Business	2.20	1.03			
There are no recent safety issues that need better communication at Major Philippine International Airport Terminal.	Leisure	2.36	0.83	1.14	0.34	Accept
	Official Gov`t	2.50	0.71			

Legend:
↓ 0. 05 is significant difference/relation - Reject
↑ 0. 05 is no significant difference/relation - Accept
↓ 0. 01 - very significant

3.3.4. Significant Difference in the Respondent' Views as Passenger in technological gaps in regards to the aviation safety at Major Philippine International Airport Based on their Purpose of Air Travel

This table evaluates passenger perceptions of aviation safety based on the purpose of travel. The results show varying levels of satisfaction, with standard deviations ranging from 0.63 to 1.10 across different travel categories. Passengers traveling for leisure purposes have a weighted mean of 2.47, those traveling for official government purposes have a mean of 2.50, business travelers have a mean of 2.27, and those traveling for educational purposes have a mean of 2.93. The data indicates that leisure and official government travelers report slightly higher satisfaction with safety measures compared to business and educational travelers. These findings suggest that passengers' satisfaction with airport services and safety can be influenced by their travel purpose, reflecting broader trends in airport service quality and safety perceptions (Bae & Chi, 2022; Nwaogbe *et al.*, 2017; D'alonzo *et al.*, 2021) [1, 19, 3].

3.3.5. Significant Difference in the Respondent' Views as Personnel in technological gaps in regards to the aviation safety at Major Philippine International Airport Based on their Position

Table 20: Difference in the Respondents' views technological gaps in regards to the aviation safety at Major Philippine International Airport Based on their Position

Statement	Airport Personnel	Mean	SD	F	Sig.	Decision
The current aviation safety technologies at Major Philippine International Airport Terminal exceed my expectations for security.	Ground Staff	2.15	0.38	0.56	0.59	Accept
	Security Personnel	2.00	0.54			
The management of Major Philippine International Airport Terminal consistently prioritizes passenger safety in their operations.	Ground Staff	2.62	0.65	0.48	0.70	Accept
	Technical Staff	2.44	0.53			
The Major Philippine International Airport Terminal is highly recommended for its effective aviation safety measures in today's environment.	Ground Staff	2.23	0.44	1.35	0.28	Accept
	Maintenance Staff	1.80	0.45			
The safety measures at Major Philippine International Airport Terminal are sufficient to effectively prevent security incidents.	Ground Staff	2.30	0.48	0.95	0.42	Accept
	Security Personnel	2.25	0.45			
The Major Philippine International Airport Terminal responds promptly to potential security threats and emergencies.	Ground Staff	2.62	0.50	0.61	0.61	Accept
	Technical Staff	2.56	0.53			
The existing safety protocols at the airport truly prioritize the staff's well-being.	Ground Staff	2.38	0.65	1.70	0.19	Accept
	Technical Staff	2.22	0.44			
The training programs are not required because the airport environment is already completely safe.	Ground Staff	2.15	0.55	1.97	0.14	Accept
	Technical Staff	1.89	0.33			
The airport management actively seeks and values staff input on improving safety measures.	Ground Staff	2.38	0.77	0.48	0.70	Accept
	Technical Staff	2.22	0.44			

Legend:
$\downarrow$ 0. 05 is significant difference/relation -Reject
$\uparrow$ 0. 05 is no significant difference/relation - Accept
$\downarrow$ 0. 01 - very significant

This table assesses the perceptions of airport personnel regarding aviation safety, including ground staff, technical staff, security personnel, and maintenance staff. The data shows varying standard deviations, with ground staff showing a range of 0.38 to 0.65, technical staff ranging from 0.33 to 0.53, security personnel ranging from 0.00 to 0.65, and maintenance staff ranging from 0.45 to 1.00. The weighted means are 2.35 for ground staff, 2.26 for technical staff, 2.09 for security personnel, and 2.15 for maintenance staff. These findings highlight the importance of staff perceptions in evaluating airport safety and service quality, with each personnel category having distinct views on safety factors. The results reflect how different staff groups prioritize safety and suggest that operational safety is perceived differently across categories (Bae & Chi, 2022; Nwaogbe *et al*., 2017; D'alonzo *et al*., 2021) [1, 19, 3].

3.3.6. Significant Difference in the Respondent' Views as Personnel in technological gaps in regards to the aviation safety at Major Philippine International Airport Based on their Length of Employment

Table 21: Difference in the Respondents' views technological gaps in regards to the aviation safety at Major Philippine International Airport Based on their Employment

Statement	Length of Employment	Mean	SD	F	Sig.	Decision
The current aviation safety technologies at Major Philippine International Airport Terminal exceed my expectations for security.	3-8 months	2.16	0.37	0.53	0.66	Accept
	1-3 years	2.08	0.29			
The management of Major Philippine International Airport Terminal consistently prioritizes passenger safety in their operations.	3-8 months	2.53	0.62	0.11	0.76	Accept
	1-3 years	2.42	0.51			
The Major Philippine International Airport Terminal is highly recommended for its effective aviation safety measures in today's environment.	3-8 months	2.11	0.46	0.41	0.52	Accept
	1-3 years	2.00	0.43			
The safety measures at Major Philippine International Airport Terminal are sufficient to effectively prevent security incidents.	3-8 months	2.47	0.61	3.03	0.07	Accept
	1-3 years	2.08	0.51			
The Major Philippine International Airport Terminal responds promptly to potential security threats and emergencies.	3-8 months	2.63	0.50	2.68	0.11	Accept
	1-3 years	2.33	0.49			
The existing safety protocols at the airport truly prioritize the staff's well-being.	3-8 months	2.32	0.67	2.62	0.11	Accept
	1-3 years	2.00	0.00			
The training programs are not required because the airport environment is already completely safe.	3-8 months	2.10	0.57	0.09	0.77	Accept
	1-3 years	2.17	0.58			
The airport management actively seeks and values staff input on improving safety measures.	3-8 months	2.31	0.67	0.49	0.49	Accept
	1-3 years	2.17	0.39			

Legend:
$\downarrow$ 0. 05 is significant difference/relation - Reject
$\uparrow$ 0. 05 is no significant difference/relation - Accept
$\downarrow$ 0. 01 - very significant

The responses in the table assess aviation safety perceptions based on employment length, revealing varying levels of perception. Employees with 3-8 months of experience showed standard deviations ranging from 0.37 to 0.67, indicating more diverse opinions, with a weighted mean of 2.33. In contrast, employees with 1-3 years had standard deviations between 0.00 and 0.58 and a weighted mean of 2.16. Employees with 4-7 years, 8-10

years, and over 10 years of experience showed uniform responses, with standard deviations of 0.00 and a weighted mean of 0.00. These results suggest that newer employees, with less experience, have more varied perceptions of

aviation safety, while long-term employees' consistent responses stem from familiarity with established protocols and airport operations (Munoz *et al*., 2019; Silva *et al*., 2022) [18].

3.3.7. Significant Differences in Perceptions of Safety between Passengers and Airport Personnel at Major Philippine International Airport

Table 22: Significant Differences in Perceptions of Safety between Passengers and Airport Personnel at Major Philippine International Airport

Statement	Significant	Decision
Airport Terminal 1's safety tech exceeds my security expectations.	0.15	Accept
Airport Terminal 1 is highly recommended for its effective aviation safety measures.	0.20	Accept
Airport Terminal 1 responds promptly to potential security threats and emergencies.	0.61	Accept
The existing safety protocols at the airport truly prioritize the staff's	0.19	Accept
The airport management values staff input to enhance safety measures.	0.70	Accept

Legend:
↓ 0. 05 is significant difference/relation - Reject
↑ 0. 05 is no significant difference/relation - Accept
↓ 0. 01 - very significant

The table evaluates safety perceptions between passengers and airport personnel, revealing responses ranging from 0.05 to 0.70, reflecting differing views on technological concerns and safety protocols. The results indicate that both groups agree on the terminal's reliance on safety and technological integration but show varying confidence levels in the effectiveness of these measures. While safety protocols

and technology are recognized, areas for improvement remain, emphasizing the importance of addressing travel risks and strengthening safety measures. Effective risk management and skilled personnel are crucial to enhancing aviation safety and gaining the trust of both passengers and staff (Carino, 2017; Majid *et al*., 2022) [2, 17].

3.4. The influence of technology on aviation safety

Table 23: Master Theme based on the informants, the influence of technology on aviation safety.

Master Theme	Superordinate Theme
The technology in Airport Terminal 1 compares to international standards for aviation safety.	Quality Improvement
	Satisfactory Performance
	Safety Procedure
Experience with the technology system currently in use at a major international airport terminal in the Philippines.	Outdated Technology
	Improvement Demands
	Limited Facilities
The effectiveness of your experience in preventing potential security risks and its influence on your perception of safety while traveling.	Poor Functionality
	Preparedness Training
	Lack of Integration

Master Theme 1.1.: The technology in Airport Terminal 1 compares to international standards for aviation safety.

Superordinate Theme 1.1.1.: Quality Improvement
- Informant 1: "...high standards with the system they use."
- Informant 2: "...could also be improved."
- Informant 3: "...they can still improve their pace."

The informant's feedback suggests that while the system is highly regarded for its consistency and ability to deliver quality improvements, there is room for enhancement. Informant 1 praised the system's strong performance, emphasizing its reliability and positive impact across various sectors. However, Informant 2 highlighted that certain features may not fully align with user needs, particularly in areas like usability, functionality, and adaptability. Informant 3 pointed out concerns with the system's speed, indicating that delays could negatively affect productivity, especially in time-sensitive tasks. Overall, the feedback reflects a system that meets expectations but has areas for improvement, particularly in speed and functionality. This balanced view

underscores the importance of maintaining strengths while addressing weaknesses to better meet evolving user demands (Knol *et al*., 2019) [13].

Superordinate Theme 1.1.2.: Satisfactory Improvement
- Informant 1: "...they would not want subpar standards…"
- Informant 2: "...if you've been to our neighboring countries...it's very advanced."
- Informant 3: "...is of course, not only the regulations issues."

Informant feedback on the technology at the major international airport in the Philippines, Terminal 1 indicates satisfactory performance, reflecting a commitment to high standards in aviation safety. Informant 1 expressed a strong expectation for quality, emphasizing the importance of meeting or exceeding international safety protocols. However, Informant 2 pointed out that compared to neighboring countries with more advanced systems, there is room for improvement to elevate the technology to regional standards. Informant 3 added that improvements should go

beyond regulatory compliance to also enhance user experience, operational efficiency, and technological advancements. Despite the terminal's satisfactory technology, feedback highlights the need for ongoing improvements to stay competitive and meet evolving safety standards. The feedback aligns with efforts to upgrade systems to ease passenger congestion and enhance efficiency, as reported by the Philippine News Agency (2023) and SITA's earlier initiatives (Airport Technology, 2017). Continuous technological enhancements are essential to meet regional benchmarks and ensure customer satisfaction.

Superordinate Theme 1.1.3.: Safety Standard
- Informant 1: "...making travel seamless and worry-free while maintaining order and security."
- Informant 3: "...equipment is not as efficient or updated as they're supposed to be."

Feedback from informants at Major Philippine International Airport Terminal 1 highlights a strong commitment to safety and a seamless travel experience. Informant 1 emphasized the goal of ensuring a worry-free journey while maintaining security, which boosts passenger confidence. However, Informant 3 pointed out concerns about outdated equipment, suggesting that inefficiency could undermine safety protocols and affect passenger flow. This gap between safety objectives and operational realities mirrors challenges at Sharm El Sheikh Airport, emphasizing the need for advanced infrastructure to meet global standards. Both airports highlight the importance of continuous investment in modern technology to improve safety, passenger satisfaction, and operational efficiency. As noted by Hassan and Salem (2021) [8], updating infrastructure and adopting advanced technologies are crucial to aligning safety practices with international standards and enhancing the travel experience.

Master Theme 1.2.: Experience with the technology system currently in use at a major international airport terminal in the Philippines.

Superordinate Theme 1.2.1.: Outdated Technology
- Informant 1: "...the technological systems in use at the airport were not as seamless compared to other countries."
- Informant 2: "...the technology at Terminal 1 is a bit behind."

Informants have expressed concerns about the outdated technology systems at Terminal 1. Informant 1 noted that the technology "was not as seamless compared to other countries," indicating an efficiency gap. Informant 2 echoed this, stating that the technology "is a bit behind," highlighting the need for improvement. While system renovations aimed at reducing passenger congestion are underway (Philippine News Agency, 2023), further upgrades are necessary. These concerns align with SITA's previous efforts to enhance efficiency and competitiveness (Airport Technology, 2017). Ongoing technological advancements are crucial to meeting evolving safety standards and regional benchmarks.

Superordinate Theme 1.2.2.: Improvement Demands
- Informant 1: "The systems I believe are still in use at
- Terminal 1 are not new nor the best ones."

- Informant 3: "...still a lot of room for improvement."

Informants highlight the need for modernization at Terminal 1 to improve passenger experience and operational efficiency. Informant 1 expressed concern about the outdated technology, stating, "The systems... are not new nor the best ones," while Informant 3 noted, "There is still a lot of room for improvement." These comments stress the potential for enhancements in areas like user interface, efficiency, and technology integration. Upgrading these systems aligns with the ATSQ study, which emphasizes that seamless, satisfying experiences drive travelers' choices (Lee & Yu, 2018) [14]. Modernizing technology would address these concerns and improve both passenger satisfaction and operational outcomes.

Superordinate Theme 1.2.3.: Limited Facilities
- **Informant** 1: "...passengers still need to queue in check-in counters, and security checks. It wasn't a terrible experience..."
- Informant 3: "...the airport, everything should be in place so that people, even they would know exactly where to go looking like a flowchart…"

Informants have expressed concerns about Terminal 1's technology and its alignment with international aviation safety standards. Informant 1 pointed out the inefficiency of traditional check-in counters and security checks, suggesting the need for improved facilities to streamline passenger processing. Informant 3 emphasized the importance of organization, advocating for clearer navigation systems to enhance the passenger experience. Immediate upgrades, such as better seating, functional escalators, and improved air conditioning, address operational inefficiencies and align with the ATSQ framework's focus on service quality. Long-term improvements, like expanding capacity and building new terminals, will resolve infrastructure constraints, enhancing passenger satisfaction and operational performance (Philippine News Agency, 2023).

Master Theme 1.3: The effectiveness of your experience in preventing potential security risks and its influence on your perception of safety while traveling.

Superordinate Theme 1.3.1.: Poor Functionality
- Informant 1: "...the system is low or not truly effective in preventing security risks."
- Informant 2: "...if the airport personnel then would put bullets in the luggage of people."

Informant 1 expressed concern that current security systems are ineffective at preventing security risks, undermining trust in the airport's safety measures. Informant 2 raised doubts about the integrity of personnel, referencing a troubling scenario where bullets were allegedly placed in passengers' luggage, further questioning the reliability of security protocols. These concerns point to an urgent need for comprehensive reviews and improvements. The limitations of traditional baggage threat detection systems, such as vulnerability to occlusion and scanner diversity, highlight the need for more robust, adaptable models. Recent advancements, like meta-learning, show promise in enhancing detection accuracy, crucial for improving

passenger safety and satisfaction (Hassan *et al.*, 2020) [9].
Superordinate Theme 1.3.2.: Preparedness Training
Informant 1: "...even airport personnel are risking the safety of passengers by not doing their jobs right."
Informant 2: "...I know the security personnel, they always undergo training

3.5. Based on the informant's findings of the study, recommended to further improve the implemented aviation safety in airport terminal 1.

Table 24: Master Theme recommended to further improve the implemented aviation safety in the airport terminal 1.

Master Theme	Superordinate Theme
Identify the specific technology you believe is lacking in a major international airport terminal in the Philippines, particularly in terms of passenger flow management, security screening procedures, technology integration, training, and preparedness.	Manual Tasking
	Outdated Technology Practices
	Training Course
Suggest possible solutions to address the challenges or issues related to technological advancement based on your observations.	Advancement Opportunities
	Stricter Controls
	Technology Limitations

Informant 1 raised concerns about the risk posed by airport personnel not properly executing their duties, which could compromise passenger safety and erode trust in the airport's security. In contrast, Informant 2 highlighted that security personnel regularly undergo training, but questioned its effectiveness in real-world situations. As major improvements are planned for baggage handling, passenger processing, and terminal capacity, it is crucial to provide preparedness training for airport staff to ensure smooth transitions, maintain service quality, and adapt to new systems. This training is key to the success of modernization efforts and enhancing the passenger experience (Philippine News Agency, 2023).

Superordinate Theme 1.3.3.: Lack of Integration
- Informant 1: "...if we have efficient and effective technological systems…"
- Informant 3: "...if there's sufficient surveillance there."

Informants have highlighted significant gaps in the airport's security framework, emphasizing the need for a more integrated approach. Informant 1 noted that the current systems lack efficiency and effectiveness, suggesting that advanced technologies are needed to bolster security. Informant 3 stressed the importance of sufficient surveillance to address potential blind spots and enhance monitoring. The lack of integration between various security systems further exacerbates vulnerabilities. Investing in integrated technologies, such as those introduced by SITA, like self-service kiosks and self-bag drops, can streamline operations, enhance connectivity, and improve both security and the passenger experience (Airport Technology, 2017).
Master Theme 2.1.: Identify the specific technology you believe is lacking in a major international airport terminal in the Philippines, particularly in terms of passenger flow management, security screening procedures, technology integration, training, and preparedness.

Superordinate Theme 2.1.1.: Manual Tasking
- Informant 1: "...the airport still uses a lot of manual labor to ensure the safety and security…"
- Informant 3: "...can be improved by using, let's say. Nonintervention safe machinery equipment…"

Informants have identified gaps in technology at the Major Philippine International Airport Terminal, particularly in passenger flow management and security procedures. Informant 1 highlighted the reliance on "manual labor" for safety and security, which leads to inefficiencies and delays. Informant 3 suggested improvements through "non-intervention safe machinery equipment," emphasizing the benefits of automating systems to streamline operations. The findings underscore the importance of integrating advanced technologies to enhance security and reduce reliance on manual labor, improving operational efficiency (Satriya & Syaputra, 2023; Okine *et al.*, 2024) [20].

Superordinate Theme 2.1.2.: Outdated Technology Practices
- Informant 1: "...it lacks the power to upgrade its existing machines and technological system to implement a seamless travel experience."
- Informant 3: "...when a certain flow of passengers through the immigration was not sufficient."

Informant 1 highlights concerns about outdated technology, stating it "lacks the power to upgrade its existing machines," which impacts the efficiency of the travel experience. Informant 3 notes issues with passenger flow, especially through immigration. These challenges underscore the need for technological upgrades to improve operational efficiency. The informants' feedback emphasizes the importance of digital transformation in airport management to enhance passenger flow and satisfaction (Wurster *et al.*, 2020) [26]. Additionally, the outdated air traffic management system in the Philippines, as reported by CAAP, reflects these technological constraints, reinforcing the need for modernized systems to ensure smoother and safer travel (Inquirer.net, 2023).

Superordinate 2.1.3.: Training Course
- Informant 1: "...lacks the machine it needs for security checks…"

The informant's comments highlight a significant gap in the security training program due to the lack of necessary machinery for security checks, which could compromise the effectiveness of the training and expose security vulnerabilities. This underscores the importance of providing sufficient resources to ensure thorough safety assessments and effective training (Wang, 2022). Additionally, the competency of airport personnel and strong safety risk management are crucial for aviation safety, and these can be weakened by the gaps in training and equipment. Ensuring adequate resources in training programs is essential for proper safety implementation (Majid *et al.*, 2022) [17].

Master Theme 2.2. Suggest possible solutions to address the challenges or issues related to technological advancement based on your observations.

Superordinate Theme 2.2.1.: Advancement Opportunities

Informant 1: "...many areas that require improvement, such as screening systems, travel information systems, check-in kiosks, and having a cybersecurity system in place…"

Informant 3: "...put in place more cameras, of course they have to be ordered integrated with the A.I. and then more sensors, more and of course, better signage is where the passengers…"

Informant 1 identifies key areas for improvement, including screening systems, travel information systems, check-in kiosks, and stronger cybersecurity measures, all essential for a safer and smoother travel experience.

Informant 1 identifies key areas for improvement, including screening systems, travel information systems, check-in kiosks, and stronger cybersecurity measures, all essential for a safer and smoother travel experience. Informant 3 emphasizes the need for increased surveillance through AI-integrated cameras, additional sensors, and better signage. These recommendations suggest a comprehensive approach to improving operational efficiency and passenger safety through advanced technologies. The integration of robust cybersecurity and AI, along with innovations like smart sensors and improved signage, is critical for enhancing functionality and passenger experience in airports (Lykou *et al*., 2019; Wurster *et al*., 2020) [15, 26].

Informant 3 emphasizes the need for increased surveillance through AI-integrated cameras, additional sensors, and better signage. These recommendations suggest a comprehensive approach to improving operational efficiency and passenger safety through advanced technologies. The integration of robust cybersecurity and AI, along with innovations like smart sensors and improved signage, is critical for enhancing functionality and passenger experience in airports (Lykou *et al*., 2019; Wurster *et al*., 2020) [15, 26].

Superordinate Theme 2.2.2.: Stricter Controls

- Informant 1: "..training personnel on newer technologies and ensuring seamless coordination between teams alike will minimize errors…"
- Informant 2: "...make a tighter security check regarding the people who are blacklisted and not allowed to leave the country."

To address the challenges posed by technological advancement, it is essential to implement stricter controls that focus on both personnel training and security measures. As highlighted by Informant 1, providing comprehensive training for staff on the latest technologies is crucial. This not only enhances their competency but also fosters seamless coordination among teams, which can significantly reduce the likelihood of errors in technology deployment and usage. Additionally, Informant 2 emphasizes the importance of tightening security protocols, particularly concerning individuals who are blacklisted and should not be allowed to leave the country. The insights from Informants emphasize that enhanced training for airport personnel plays a crucial role in improving aviation safety performance (Majid *et al*., 2022) [17]. It is also highlighted that the need for strategic management in adapting to advanced technology could reduce risks to ensure both the effective implementation of technology and the enforcement of security standards (Wurster *et al*., 2020) [26].

Superordinate Theme 2.2.3.: Technology Limitations

- Informant 1: "...the management is willing to invest and efficiently implement such systems…"
- Informant 2: "...automation that will be in the energy section, also in the immigration section. All of that will improve airports."

Informants emphasized the potential for technological advancements at Terminal 1, with Informant 1 noting that "the management is willing to invest and efficiently implement such systems," indicating readiness for digital

4. Discussion

This study examined the impact of technological modernization on aviation safety at a major Philippine international airport terminal using a mixed-methods approach. The findings reveal significant gaps in passenger flow management, security screening procedures, technology integration, and staff training, highlighting areas requiring urgent improvement to meet international standards.

- **Key Findings on Technological Gaps**
  The results indicate widespread dissatisfaction among both passengers and airport personnel regarding current safety technologies and procedures. In passenger flow management, respondents consistently disagreed that the terminal handles congestion effectively (Weighted Mean=2.29), with particular concerns about facility adequacy and entrance efficiency. These findings align with prior research (Bae & Chi, 2022) showing that poor passenger flow management negatively impacts traveler experience. Security screening procedures also received low ratings (WM=2.34), echoing Güres *et al*.'s (2017) findings about the importance of efficient security processes. Notably, technology integration scored lowest (WM=2.29), with concerns about outdated systems and cybersecurity vulnerabilities supporting Lykou *et al*.'s (2019) arguments for enhanced digital security in airports.

- **Divergent Perceptions Between Stakeholders**
  The study revealed interesting disparities between passenger and personnel perspectives. While passengers showed moderate agreement about management prioritizing safety (WM=2.69), airport personnel expressed stronger disagreement across all safety measures (WM=2.16-2.53). This discrepancy suggests that operational realities known to staff may not be visible to passengers, emphasizing the need for better communication and transparency in safety practices.

- **Demographic Variations in Perceptions**
  Age and travel frequency significantly influenced safety perceptions. Younger passengers (18-25 years) demonstrated more critical views than middle-aged travelers, possibly due to higher expectations of technological integration. Frequent travelers showed more consistent but generally lower satisfaction levels compared to occasional travelers, supporting Lee and Yu's (2018) [14] findings about how travel experience shapes airport service expectations. Among personnel, those with shorter tenure (3-8 months) displayed more varied perceptions than longer-serving staff, suggesting that familiarity with systems may lead to normalized acceptance of suboptimal conditions.

- **Qualitative Insights and Recommendations**
  Informant interviews provided crucial context to the quantitative data, revealing three major themes:
1. **Technology Deficiencies**: Staff highlighted reliance on manual processes and outdated equipment, particularly in security screening and passenger processing. These observations corroborate Wurster *et al*.'s (2020) [26] findings about digital transformation challenges in airport management.
2. **Training Gaps**: Personnel emphasized inadequate preparation for technological failures, supporting Majid *et al*.'s (2022) [17] argument that staff competency directly impacts safety performance.
3. **Integration Challenges**: Informants noted poor system interoperability, echoing Hassan *et al*.'s (2020) [9] call for unified security technologies.

Practical Implications
The study suggests three key improvement areas
1. **Technology Upgrades**: Immediate investment in automated screening systems, AI-enhanced surveillance, and integrated passenger flow management tools.
2. **Workforce Development**: Comprehensive training programs focusing on new technologies and emergency response protocols.
3. **Process Optimization**: Redesign of security checkpoints and boarding procedures to reduce bottlenecks, informed by Knol *et al*.'s (2019) [13] cognitive agent models.

5. Conclusion
1. The feedback gathered from informants offers a critical yet constructive perspective on operations and infrastructure. Key issues identified include inefficiencies in passenger processing, such as long security and immigration lines, delays at check-in, and inadequate safeguards for personal belongings. Additionally, concerns were raised about the technological infrastructure, particularly the need for reliable systems, enhanced cybersecurity, and improved baggage handling solutions to meet passenger expectations and ensure smooth operations. Another area of concern is staff training and preparedness, with respondents recognizing positive employee attitudes but highlighting gaps in training programs and readiness for technological disruptions.
2. The results reveal significant concerns from both passengers and personnel regarding safety and security in aviation. Nearly all passengers express dissatisfaction with the management's handling of safety issues, emphasizing the need for improvements in safety measures, communication, and operational practices. While some passengers feel secure, there is a widespread perception that safety management, particularly in emergencies and overall preparedness, is lacking.
3. The analysis of aviation safety perceptions highlights significant demographic differences. Passengers aged 18-25 tend to have more varied and critical views, likely due to higher expectations for service quality and technology, while those aged 26-40 are generally more favorable, reflecting greater familiarity with airport procedures. Older passengers (41 and above) tend to be more optimistic, possibly due to their experience and comfort with airport services. Male passengers exhibit greater variability in safety perceptions, while female

passengers tend to have more consistent views. Among employees, males show more diverse perceptions, while females are generally more positive. Frequent travelers report consistent safety perceptions, while first-time and infrequent travelers show greater variability. Travel purpose also influences perceptions, with leisure and government travelers generally more satisfied than business or educational passengers. Additionally, newer employees exhibit more varied safety perceptions compared to long-term staff, emphasizing the need for continued training transformation. Informant 2 highlighted areas for automation, such as the energy and immigration sections, which could improve operational efficiency. These discussions underscore the importance of smart technologies to enhance processes and maintain security, ensuring Terminal 1 keeps pace with other airports (Wurster *et al*., 2020; Lykou *et al*., 2019) [15, 26].
4. Overall, while there is confidence in safety protocols and technology, improvements in risk management and staff competency are needed to further enhance safety and trust.
5. The feedback from informants reveals a generally positive yet balanced view of the available technology systems. While these systems reflect a commitment to high standards and satisfactory performance, several areas for improvement were identified. Informants emphasized the need to enhance system speed, modernize outdated technology, and improve operational efficiency to meet regional and international benchmarks.
6. Additionally, they highlighted the necessity of a more integrated security framework, with a focus on improving surveillance systems and enhancing tools to ensure passenger safety and smooth operations. The feedback also suggests that ongoing technological upgrades will be essential to maintaining safety, improving customer satisfaction, and ensuring competitiveness in an increasingly tech-driven industry. Addressing these areas will help the airport meet evolving safety standards and operational requirements, ultimately enhancing both safety and the passenger experience.
7. The findings shed light on the existing key areas to improve technology to enhance aviation safety and efficiency. Areas of issues have been encountered in the instances of passenger flow, security screening, and immigration in terms of their reliance on outdated man-to-man processes. The informants suggested bringing automated systems and AI-powered surveillance; also, upgrade the screening, kiosk check-in, and cybersecurity to improve operations and more on training to ensure the effective usages and less occurrence of mistakes. Handling these areas can better the running of an airport, improve efficiency, safety of the passenger, and travel by large extent.

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