Assessing the Impact of Pre-Flight Inspection in Preventing Hazards: A Case Study of 360 - Checks

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Abstract: - A major priority for the aviation industry is how to prevent accidents and incidents. One of the ways in ensuring that during the duration of the flight, starting from the start of the engine until the engine is shut down, is the pre-flight inspection, or what is also called 360-checks. A 360-check is one of the risk mitigation practices by aviation organizations conducting flight operations. This study aims to determine the impact of pre-flight inspection in preventing hazardous situations from happening during flight. This research study was conducted on the pilots of Omni Aviation Corporation. The researcher analyzed the frequency of hazards that occur during the flight, the importance of inspecting the aircraft's structure for the pilots, as well as the importance of inspecting the quality and quantity of the fuel and oil inside the aircraft. As pre-flight inspection is an important aspect of ensuring safety, it is significantly appropriate to be applied as this study's variable, especially for pilots who are still training and gaining experience.

Key Words— ***Pre-flight Inspection, 360-Checks, Pilot Training, Hazards, Safety.***

I. INTRODUCTION

In the aviation industry, safety is one of the most important factors to consider. Whether it is during the flight itself, after the flight, or even before the flight has started. Aside from effectively running the operations, the organization must always implement safety standards, rules, and regulations to members of the company. This is done to keep ourselves and others away and free from harm. Safety must always take into consideration the possible hazards and the risk that may happen as soon as an aircraft is started. One of the duties of a pilot is to ensure that the aircraft they will be flying is an airworthy aircraft, and the method to identify an airworthy aircraft is thru the pre-flight inspections (hereinafter may be referred to as 360-checks).

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The pre-flight inspection is a crucial step in preventing and mitigating in-flight hazards. The main purpose of the 360-check is to allow the Pilot-in-Command (hereinafter may be referred to as PIC), to visually inspect the fuel and oil quality and quantity, as well as the structures, namely the fuselage, empennage, wing/s, landing gear, and powerplant of the airplane. The PIC has to confirm that the airplane meets the standards of an airworthy aircraft.

According to a handbook released by the Federal Aviation Administration (2021), the pre-flight inspection can be divided into two parts. The first part involves the pilot inspecting the airplane's airworthiness status and a visual pre-flight inspection of the airplane following the pilot's operating handbook of the aircraft to determine the required items for inspection. The second part involves the owner or the operator, they are primarily responsible for the maintenance of the aircraft. But overall, the PIC is solely responsible for ensuring the airworthiness and safety of the airplane for flight [1].

Before starting the flight, aside from visually inspecting the aircraft, a lot of logbooks and documents must be updated and present inside the aircraft. Considering this, it's important for

the pilots to have a checklist for the pre-flight, starting, and pre-takeoff checks so that nothing is overlooked [2].

According to an article written in 2016, some pilots have started to consider the pre-flight inspection as waste of their time. This thinking is an unsafe act, a hazard waiting to happen. They would likely change their thinking if they experienced an in-flight problem which they should have discovered and mitigated while still on the ground if they did not skip or had done their 360-check properly. The same article said, "this is the essential purpose of the procedure—to leave potential problems on the ground [3].

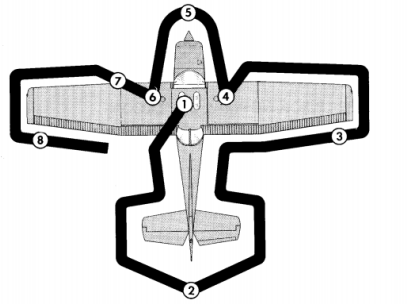

Fig. 1.1 The 360-check walk around (Cessna 152)

An example of how the 360-check is done is shown in Fig 1.1. The pilots must visually inspect the airplane for general condition. If a night flight is planned, the pilots are required to check the operation of all lights and make sure a flashlight is available. An example of how a 360-check from the Pilot's Operating Handbook on a Cessna 152 is seen below [4].

1.1 Cabin

- Pilot's Operating Handbook – AVAILABLE IN THE AIRPLANE
- Control Wheel Lock REMOVE
- Ignition Switch –OFF
- Avionics Master Switch – OFF
- Master Switch – ON
- Fuel Quantity Indicators – CHECK QUANTITY
- External and Interior lights – ON (if night flight is contemplated—check to ensure that all are working)
- Pitot Heat –ON (if flight in instrument conditions is contemplated – check to ensure that pitot tube is warm to touch within 30 seconds)
- Lights and pitot heat – OFF
- Master Switch – OFF
- Fuel valve – ON

1.2 Empennage

- Rudder Gust Lock REMOVE
- Tail Tie –down – DISCONNECT
- Control Surfaces – CHECK for freedom of movement and security

1.3 Right Wing- Trailing Edge

- Aileron –CHECK freedom of movement and security

1.4 Right Wing

- Wing tiedown – DISCONNECT
- Main Wheel Tire – CHECK for proper inflation, cuts, wear
- Brake lines – CHECK for leaks
- Fuel sump – CHECK before first flight of day, and after each refueling, drain fuel sample from sump, checking for water and other contaminants
- Fuel Quantity – CHECK VISUALLY
- Fuel Filler Cap --- SECURE

1.5 Nose

- Engine Oil –4 quarts minimum –5 quarts maximum for flights less than 3 hours—6 quarts maximum
- Engine Oil cap –SECURE
- Before first flight of day, and after each refueling, pull out fuel strainer knob for 4 seconds
- Propeller and spinner – CHECK for nicks and cracks
- Air intake – CHECK for obstructions
- Nose wheel strut– CHECK for inflation,
- Nose wheel tire – CHECK for inflation, cuts, wear
- Nose tiedown -- REMOVE

1.6 Left Wing

- Wing tiedown – DISCONNECT Pitot tube – REMOVE COVER –CHECK for obstruction, damage
- Main Wheel Tire – CHECK for proper inflation, cuts, wear
- Brake lines – CHECK for leaks
- Stall warning vane – CHECK
- Fuel sump – CHECK before first flight of day, and after each refueling, drain fuel sample from sump, checking for water and other contaminants.
- Fuel Quantity – CHECK VISUALLY
- Fuel Filler Cap --- SECURE

1.6 Left Wing- Trailing Edge

- Aileron –CHECK freedom of movement and security

II. Related Literature

2.1 Pre-flight Inspection

The pre-flight inspection is the last chance of a pilot to determine the safe operational conditions of an airplane. In the study of Keesey and Hoffman (2012), they recommended that

the pilot should start with the manufacturer's checklist if it is available. Keesey also advised in letting a checklist form the basis of a pre-flight inspection, but he also warned not to let the checklist limit what they should check. He stated that there is no one-size-fits-all when it comes to checklists [5].

The general practice for learning how to do the 360-check procedures typically involves significant instructor involvement for the first few pre-flights, after which the students conduct them on their own with limited supervision and minimal instructor input. If the proper methodology is taught initially, additional training, when needed, on neglected and key indicator areas should be enough to create a safe aviator [6].

The FAA requires a pilot to determine that the airplane's logbooks, certificates, and other documents are updated and provide factual assurance that the aircraft meets its airworthy requirements. After ensuring this, it is appropriate to visually inspect the airplane. The visual pre-flight inspection of the airplane should begin while approaching the airplane on the ramp. The pilot should take note of the general appearance of the airplane and for discrepancies such as misalignment, dents, cracks, and hinges of the airplane structure [1]. According to the finding of a study, most pre-flight inspections are conducted under the assumption that flight will follow. In most, if not all, situations, an aircraft will depart an airport and arrive safely at the intended destination without incidents. No one can argue with incident-free flight operations, but such impressive safety records can lead to the hazardous attitude of invulnerability [6]. A pilot with this attitude has the mentality that "bad things won't happen to me" [7], and can lead to the pilot's lax and complacent attitude in doing their 360-checks.

Inadequate pre-flight inspection is caused by either insufficient training or complacency. Therefore, pilots must learn the proper method of a good pre-flight and why they have to do it [3].

2.2 Hazards

According to the Federal Aviation Administration, there are ten most frequent causes of accidents in the general aviation that involves the PIC. One of them is an inadequate pre-flight preparation and planning [8]. According to them, the list has remained relatively stable, and they also pointed out the need for continued refresher training or recurrency training to establish a higher level of flight proficiency for all pilots.

An article released by the Civil Aviation Safety Authority of the Australian Government states that a hazard is a condition in which there is a potential to cause an aircraft incident and/or accident. They also stated that "hazards are an unavoidable part of aviation activities" but they emphasized that these hazards can be managed through mitigation strategies that can contain the potential for the hazard to result in an unsafe condition. If these hazards cannot be contained, at the very least, they can still reduce the amount of risk [9]. Hazard identification is the first step in the safety management process.

III. METHODOLOGY

The researcher used a quantitative approach to learn and evaluate the impact of pre-flight inspections in preventing hazards during the flight phase. The researcher utilized deductive reasoning in which the researcher defined the study's purpose, collected data through electronic form and questionnaires and the findings when statistical treatments were applied. The information was collected between the October and November 2022. All information through surveys were gathered from flight instructors, ground instructors, and active students of Omni Aviation Corporation only.

In this study, purposive sampling or judgmental sampling was used to select samples from the different strata of the population. The total population for this study is 60 respondents. Purposive sampling is a non-probability sampling in which researchers choose people of the population to participate in their surveys based on their judgement. This survey sampling technique demands researchers to be familiar with the goal of their studies to correctly choose and approach qualified respondents for interviews performed via questionnaire.

To make the results easier to understand, the researcher used Table 1.1 to identify how often some common hazards are experienced during the flight. Table 1.2 was then used to interpret and assess the importance put by the pilots in conducting the 360-checks on the structures and fuel and oil of the aircraft. These two tables were used as guide to interpret the results. The researcher used descriptive analysis to calculate the results.

Table 1.1 Interpretation of the Four-point Likert Scale for Section II of the Questionnaire

Likert Scale	Interval	Description
1	1.00-1.75	Never
2	1.76-2.50	Seldom
3	2.51-3.25	Sometimes
4	3.26-4.00	Often

Table 1.2 Interpretation of the Four-point Likert Scale for Section II of the Questionnaire

Likert Scale	Interval	Description
1	1.00-1.75	Strongly Disagree
2	1.76-2.50	Disagree
3	2.51-3.25	Agree
4	3.26-4.00	Strongly Agree

IV. RESULTS AND DISCUSSION

The data employed in the following analysis was obtained from sixty (60) student pilots and instructors of Omni Aviation Corporation.

Table 2.1 Assessment on the Frequency of Hazards Experienced During Flight

	Mean	Std. Dev.	Range
Assessment on the Hazards Experienced During Flight.	**1.40333**	**0.47746**	**1-4**
1. Visible Loose Screws	2.46667	0.96492	1-4
2. Doors/windows Opened	2.03333	0.97366	1-4
3. Flight Instrument Problems	1.21667	0.41545	1-4
4. Landing Gear Tire Malfunctioned	1.11667	0.32373	1-4
5. Burnt Out Exterior Lights	1.21667	0.41545	1-4
6. Landing Gear Brake Failure	1.15000	0.36008	1-4
7. Fuel Tank Emptied Out	1.00000	0.00000	1-4
8. Flight Control Problems	1.13333	0.34280	1-4
9. Engine Problems	1.26667	0.44595	1-4
10. Problem Resulting in Major Repairs	1.43333	0.53256	1-4

Table 2.1 above shows the descriptive statistics of the variables in determining the frequency of hazards experienced during flight. To interpret the results, Table 1.1 was used. The data shows that the overall frequency of hazards experienced has a mean of 1.40833 with a standard deviation of 0.49944, this can be interpreted as a "never" result. This is further supported by looking at items 3 - 7, as the said items have a mean that is between 1.00-1.75. From the data, we can see that items 1 and 2 have a mean that is between 1.76-2.51, which can be interpreted as “seldom”.

Table 2.2 Assessment on the Importance of 360-Checks on the Structures

	Mean	Std. Dev.	Range
Assessment on the Importance of 360 - Checks on the Structures.	**3.72909**	**0.60744**	**1-4**
1. Inspects the Fuselage for Dents and Cracks	3.74545	0.58431	1-4
2. Inspects the Empennage for Dents and Cracks	3.78182	0.56735	1-4
3. Inspects the Wings for Dents and Cracks	3.74545	0.61518	1-4
4. Inspects the Landing Gear Assembly	3.67273	0.61024	1-4
5. Inspects the Propeller for Dents and Cracks	3.65455	0.64458	1-4
6. Inspects the Vertical and Horizontal Stabilizers	3.74545	0.67720	1-4
7. Inspects the Flight Controls	3.72727	0.59175	1-4
8. Inspects the Cabin Doors	3.74545	0.61518	1-4

	and Windows			
9.	Inspects the Exterior Lights	3.74545	0.58431	1-4
10.	Inspects the Pitot Tube and Static Port	3.72727	0.59175	1-4

The data concerning the importance of the structure of the aircraft for the pilots is shown in Table 2.2 above. The overall rating falls under the range of " strongly agree," having a mean of 3.72909 and a standard deviation of 0.60744. Among the 10 items, the 2nd item got the highest mean at 3.78182, which interprets as "agree."

Table 2.3 Assessment on the Importance of 360-Checks on the Fuel and Oil

	Mean	Std. Dev.	Range
Assessment on the Importance of 360 - Checks on the Fuel and Oil.	**3.83667**	**0.38349**	**1-4**
Inspects the amount of Fuel in the Fuel Tank	3.86667	0.34280	1-4
Inspects the Fuel Sump for Contaminants	3.91667	0.27872	1-4
Inspects the Fuel Cap	3.83333	0.32373	1-4
Inspects the amount of Oil	3.83333	0.37582	1-4
Inspects the Oil for Contaminants	3.68333	0.59636	1-4

The last section of the survey is shown in Table 2.3. It shows the descriptive results of the questions in regards to the importance of the quality and quantity of fuel and oil for the pilots. The overall average for this section falls under the range of " strongly agree," with a mean of 3.83667 and a standard deviation of 0.38349. This mean result almost reaches a 4.0000 result.

These results were intended to answer three critical problems under this study: to identify the frequency of certain hazardous situation that can happen during flight and to also know if the pilots give importance to inspecting the structures, fuel, and oil of the aircraft during their 360-checks.

4.1 Frequency of Hazardous Situations

Based on the results from Table 2.1, the data reveals that the occurrence of hazardous situations during flight can be considered as “never happened”. However, this does not mean that occurrence of hazardous situations are really non-existent. By looking at the mean of the situations such as pressure instrument problems, landing gear/s malfunctioning, burnt out exterior lights, landing gear brake failure, flight control problems, engine problems, and problems which resulted in major repairs can be considered as never happened. With careful analysis, the numbers do not show an exact 1.00000 mean. This means that situations like this have happened, although very rarely. But there is a situation in which none of the respondents have ever experienced, which is the total emptied out fuel tank.

The results also show 2 situations in which received a mean interpretation of “seldom”. These 2 situations are visible loose screws and door and/or windows open during flight. This means that these situations have happened at certain occasions. Especially for visible loose screws situations as its mean is very close to reaching the mean range for “sometimes”.

4.2 Importance of Inspecting the Aircraft Structures for the Pilots

By analyzing the data shown in Table 2.2, the participants can be said to place a very high importance in doing their 360-check on the structures of the aircraft. Most of the respondents place a very high importance in inspecting the empennage of the aircraft as it has the highest mean. This does not mean that the respondents do not place importance on the other parts of the aircraft as the results are just close to each other.

4.3 Importance of Inspecting the Aircraft’s Fuel and Oil for the Pilots

The last part of the survey analyzes the importance of the quantity and quality of the aircraft’s fuel and oil for the pilots of Omni Aviation Corporation. Based on the results, inspection for the amount of fuel in the fuel tank, inspection for fuel contaminants, inspection for proper closing of fuel caps, and inspection for oil quantity does not have a mean that is lower than 3.8000. This indicates that most of the respondents place a very high importance in these 4 items. Despite having a mean

of 3.68333, the pilots still place a very high importance in inspecting the oil sump for contaminants.

V. CONCLUSION

Aircraft inspection is an integral part in determining and ensuring the airworthiness of an aircraft. The pre-flight inspection can be considered as the last safeguard in ensuring that the flight would be smooth and safe. The 360-checks conducted by a pilot is very important, especially in preventing certain hazardous situations. Based on the data and literature analyzed, the researcher has concluded that hazardous situations happen infrequently during the flight. This stems from the importance that the pilots have put into doing their 360-checks, especially on the aircraft's structures, fuel, and oil. The results from the data gathered further proves this claim. The researcher therefore concludes that a proper pre-flight inspection has a huge impact in preventing hazardous situations.

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