# Incorrect Surfaces Phase II

## Background

Incorrect surface events are those instances where an aircraft attempts, or conducts a takeoff, approach, or landing to an incorrect surface (e.g., wrong runway, wrong airport, taxiway, or unprepared surface). These runway events pose a significant hazard to all aircraft operating in the vicinity of the event. Of the 557 incorrect surface approach and landing events from fiscal 2016 to fiscal 2018, 85% involved General Aviation (GA) aircraft. During that same period, there were also 464 incorrect surface departure events. 89% of these events occurred during daylight hours with visibility of 3 statute miles or greater.

Previous studies for these events had been Part 121-focused. In July 2019, the GA Joint Safety Committee (JSC) requested that the GA Issues Analysis Team (IAT) extend the November 2017 Medium Fidelity Study on Incorrect Surfaces to include a larger GA focus. Phase I of the GA study was completed in November 2020 and resulted in an analysis that quantified Incorrect Surface events including locations, aircraft and operation types, as well as which type of incorrect surface event occurred.

Phase II of the Incorrect Surfaces study was initiated to further analyze Phase I results to identify human and operational contributing factors to incorrect surface events. This study further identifies why these events occur to better inform and support mitigation efforts.

## Question(s) to be Answered

a) What are the factors that contribute to incorrect surface events?

## Relevant Data Sources

| Text Reports | | | |
|---|---|---|---|
| **ASAP** | **ATSAP** | **MOR** | **ASRS** |

## Approach

Phase I of the study produced 2,786 reports that were positively identified as incorrect surface events. These reports were drawn from the ASIAS database of Relevant Data Sources.

Phase II of the study identified contributing factors using two methodologies:

1. Subject matter expert (SME) review of a random sample of the entire data set (15%)
2. The development and utilization of topic modeling methodologies for the entire data set

SME review of the random sample tagged each report with one or more contributing factors utilizing an established taxonomy that was developed for the Approach and Landing Misalignment (ALM) Directed Study. The ALM taxonomy established 10 categories of contributing factors (see Figure 1 below) that are directly applicable to the analysis of GA incorrect surface events. Each of these 10 categories is further broken out into specific "tags" that describe a contributor within that category. For example, the Flight Crew Error category is broken out into 8 specific tags:

- Flight Crew Error
  - Crew communication or Coordination
  - Inadequate planning or preparation
  - Wrong altimeter setting
  - FMC programming
  - Failure to communicate with ATC
  - Failure to monitor/cross check
  - Pilot deviation
  - Unknown/Other

More explicit definitions for each of the tags identified in this report can be found in Appendix B.

Topic modeling algorithms were also developed to identify contributing factor word groups across the entire data set. These topics were then reviewed by a SME and categorized appropriately utilizing the ALM taxonomy. A seeded topic modeling proof of concept approach was also developed to see if topic modeling results could be further refined.

## Results Summary

SME review and topic modeling results were aggregated to display the count of contributing factors that appeared in each of the 10 ALM taxonomy categories as seen in Figure 1.

| ALM Taxonomy | Flight Crew HF | Flight Crew Error | Environment | ATC Error | ATC HF | ATC Operations | Airport Operations | Airport Layout | Aircraft | Airspace System |
|---|---|---|---|---|---|---|---|---|---|---|
| ALM Taxonomy Category Totals | | | | | | | | | | |
| 604 | 1,208 | 90 | 50 | 178 | 54 | 19 | 79 | 88 | 4 | |

Figure 1. ALM Taxonomy Contributing Factors

The analysis of the data sets utilizing both SME review and topic modeling yielded 1,573 tags across all data sets. The largest contributors to incorrect surface events (not all inclusive) are shown in Figure 2.

| Topic Area | Analysis Records | Contributing Factors |
|---|---|---|
| Flight Crew Error | 1,208 | Failure to monitor/cross check - Pilot deviation – Planning - Communications |
| Flight Crew HF | 604 | Distraction; Unfamiliar/inexperience; Expectation bias; Task Saturation; Complacency |
| Environment | 90 | High winds; Clouds; Low visibility; Natural lighting |
| Airport Layout | 79 | Visual similarity to nearby airport; Visual similarity to another surface |
| ATC HF | 178 | Auditory or visual information misinterpreted; Distraction; Task Saturation |
| ATC Operations | 54 | Change in expected clearance |

Figure 2: Incorrect Surface Contributing Factors Concentration Areas

Analysis Question: The contributing factors summary table shown in Figure 2 contains the dominant factors that drive the occurrence of incorrect surface events in the National Airspace System (NAS). Contributing factors definitions can be found in Appendix B.

## Appendix A: Acronyms & Initializations

| Term | Definition |
|---|---|
| **ASAP** | Aviation Safety Action Program |
| **ASIAS** | Aviation Safety Information Analysis and Sharing |
| **ASRS** | Aviation Safety Reporting System |
| **ATSAP** | Air Traffic Safety Action Program |
| **GA IAT** | General Aviation Issues Analysis Team |
| **GA JSC** | General Aviation Joint Steering Committee |
| **GA SAT** | General Aviation Safety Analysis Team |
| **HF** | Human Factors |
| **MOR** | Mandatory Occurrence Report |
| **NAS** | National Airspace System |

## Appendix B: Contributing Factor Definitions

### Pilot Error

1. Failure to monitor/cross check - Any mentioned event or issue where the flight crew failed to perform their monitoring function responsibilities, failed to crosscheck or verify the result of a selection (e.g., flight mode annunciator (FMA), aircraft configuration), or did not recognize and counteract complacency.
2. Pilot deviation - Any mentioned event or issue where a flight crew misjudges the turn to final, overshoots final, or deviates from procedure leading to a potential misalignment.
3. Planning - Any mentioned event or issue where the flight crew did not adequately prepare for the pre-flight task or during the flight, due, for example, to an inadequate briefing, not being mentally prepared, or an inadequate assessment of weather.
4. Communications - Any report in which pilot human factors (e.g., environmental, medical, or workload factors; the man-machine interface; or other human characteristics which influence behavior) are mentioned or questioned but cannot be categorized in any way because the reasoning is unknown.

### Pilot Human Factors

1. Distraction - Any mentioned event or issue where the flight crew was distracted by other duties, or where the narrative mentions that they should not have allowed another external event or issue to create a distraction. Examples include preoccupation with inappropriate tasks or failure to correctly prioritize the critical tasks under time constraints, including preoccupation with automated systems (FMC) to the exclusion of alternative navigation systems.
2. Unfamiliar/inexperience - Any mentioned event or report that mentions a pilot's unfamiliarity or inexperience with an airport, procedure, or aircraft type that potentially influenced the outcome of the event.

3. Expectation bias - Any mentioned event or issue where a pilot's expectation for the outcome incorrectly influences the flight crew's behavior leading to potential misalignment. (e.g., a pilot expects runway 28R because that's the norm, and doesn't realize they are cleared to runway 28L)
4. Task saturation - Any mentioned event or issue where a pilot cited task saturation or high workload, including those instances where the pilot's own actions/inactions subsequently increased their own workload. An example may include instances where the crew stated they should have used different automation modes to decrease workload.
5. Complacency - Any mentioned event or issue where the flight crew reports decreased vigilance due to boredom, overconfidence, modern flight deck automation capabilities, and/or the compelling nature of advanced avionics and map displays.

**Environment**

1. High winds - Any mentioned event or issue that is related to high head, cross, or tail winds leading to deviations from the desire track or vertical path.
2. Clouds - Any mentioned event or issue related to clouds or low visibility where the pilot or controller mentions difficultly in visually identifying the runway or aircraft.
3. Low visibility- Any mentioned event or issue related to clouds or low visibility where the pilot or controller mentions difficultly in visually identifying the runway or aircraft.
4. Natural lighting - Any mentioned event or issue where natural lighting impacted a flight crew's or ATC's performance. (e.g., Sun is low on the horizon and shines directly on the flight crew's eyes during a visual approach.)

**Airport Layout**

1. Visual similarity to nearby airport - Any report or event which mentions the visual similarity between nearby airports leading to wrong airport approaches/landings. The airport proximity does not necessarily make it visually similar.
2. Visual similarity to another surface - Any report or event in which the incorrect surface looks visually similar to the correct runway from the perspective of the flight crew. (e.g., a taxiway pavement looking like a runway.) This is not to be used for a pilot's or controller's confusion with another parallel runway.

**Air Traffic Control Human Factors**

1. Auditory or visual information misinterpreted - Any mentioned event or issue noting a controller's misinterpretation of auditory or visual information.
2. Distraction - Any mentioned event or issue where the controller was distracted by other duties, or where the narrative mentions that they should not have allowed another external event or issue to create a distraction.
3. Task saturation - Any mentioned event or issue where an air traffic controller cited task saturation or high workload.

**Air Traffic Control Operations**

1. Change in expected clearance - Any mention of events or reports where the clearance to an expected runway is changed by ATC during approach or across controller.