Data Analysis of ASRS Runway Incursion Incident Reports

NTSB Runway Incursion Forum, Office of Aviation Safety

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(Metis Technology)

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Runway Incursion – ASRS Definition

- “Unauthorized, uncoordinated, or improper entry to any active runway by an aircraft, vehicle, or person.”

- ASRS Runway Incursion definition since program inception (1975)
2017 data was projected based on reports received through August 16th.

Source: ASRS Screening Data Set (100%)
ASRS Runway Incursion Incident Reports

*2017 data was projected based on reports received through August 16th.

Source: ASRS Screening Data Set (100%)
ASRS Runway Incursion Incident Reports

- January 1, 2012 to August 16, 2017

- **ASRS All Reports Received**: 482,725
- **Runway Incursion Reports (ASRS Screening Data 100%)**: 11,168
- **Runway Incursion Records (Primary Analysis)**: 770
- **Secondary Analysis of most recent runway incursion records**: 150
ASRS Runway Incursion Incident Reports

Runway Incursion Reports Received

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**Reporter Type (Affiliation) and Year**

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*2017 data complete through August 16th.*

Source: ASRS Screening Data Set (100%)
ASRS Runway Incursion Incident Reports

Top 15 Concurrent Anomalies

- ATC Issues: 2,730
- Ground Conflict, Less Severe: 1,588
- Taxiway Incursion: 580
- Aircraft Equipment Problem - Less Severe: 304
- Track / Heading Deviation: 281
- Airborne Conflict: 182
- Airspace Violation: 174
- Ground Conflict, Critical: 148
- Landing Without Clearance: 148
- Inflight Weather / Turbulence Encounter: 107
- Ground Event / Encounter - Vehicle: 41
- Critical Aircraft Equipment Problem: 23
- Flight Deck / Cabin / Aircraft Event - Illness: 22
- Unstabilized Approach: 18
- Ground Event / Encounter - Object: 16

Categories are not mutually exclusive. Therefore, a single incident may be coded by ASRS analysts as involving more than one anomaly.

Source: ASRS Screening Data Set (100%)
## Top 20 Airports by Year

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*2017 data complete through August 16th.
Source: ASRS Screening Data Set (100%)
ASRS Runway Incursion Incident Records

- Primary Analysis Data Records
- Data includes Runway Incursion incidents occurring from January 1, 2012 to August 16, 2017
- n = 770 Records (Multiple matching of 1,070 reports)

Towered Airport and Non-Towered Airport Events

*2017 includes incidents occurring through August 16th and fully processed in the ASRS database. Data references ASRS reports that have received primary analysis and include the reporter's narrative.
Categories are not mutually exclusive. Therefore, a single incident may be coded by ASRS analysts as involving more than one anomaly. Data references ASRS reports that have received primary analysis and include the reporter's narrative.
ASRS Runway Incursion Incident Records

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Communication Breakdown – Reported Explanations

- Airport Information Dissemination Systems (ATIS, ASOS, etc.)
- Blocked/Stepped-On Transmissions
- Equipment Issues
- Expectation Bias
- Frequency Congestion
- Incomplete/Insufficient Clearance Information
- Intrafacility/Interfacility Coordination Issues
- Language Barrier
- Memory Lapse
- Misunderstood Clearance
- Non-Standard Phraseology or Procedure
- Readback/Hearback
- Similar Callsign
- Wrong Aircraft was Issued/Took Clearance

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“…Tower inquired if we had already crossed the line and I acknowledged that we had. We were then cleared for an immediate departure. The small general aviation aircraft was asked to make a 180 back across his hold short line. … When in question VERIFY! I did not do this. Verify your call sign in ANY ATC radio transmission. I assumed the takeoff clearance was for us and due to partially blocked radio call, missed the fact that it was not for us.”

(ACN 1447207 Excerpt)
### Confusion – Reported Explanations

- Airport Chart
- Airport Construction
- Airport Layout, Runway Configuration
- Airport Maintenance/Condition
- Airport Marking Issues
- Airport Signage Issues
- Language Barrier
- Policy/Procedure
- Readback/Hearback
- Similar Callsign
- Unclear ATC Instruction/Clearance
- Untimely ATC Instructions
- Weather Elements

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Data references ASRS reports that have received primary analysis and include the reporter’s narrative.

…”As I came towards the end of what would be the downwind, I started to question whether I was understanding the layout of the runways. Buchanan has 4 runways in a set of two that are 30 degrees different from each other. It is a very confusing airport.”

(ACN 1443828 Excerpt)
**Distraction – Reported Explanations**

- Airport Construction
- Airport Maintenance/Condition
- Checklist, Chart, or Other Documentation
- Co-worker Interruption/Interference
- Equipment Issue
- Non-Standard Phraseology
- Performing Heads-Down Task
- Scanning Traffic
- Traffic Volume
- Untimely ATC Instructions
- Visual Cues (Airport Markings/Signage)
- Weather Elements

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“...Contributing factors were numerous taxiway and runway closures due to construction. This has been going on for an extended period of time. I listened to ATIS and copied the closures and other NOTAMS. This is my home airport, so the construction was not new to me. Also the flight was going to be long with a fuel stop, and arrival weather considerations in [destination]. This possibly distracted me from the non-standard taxi to 22L and ending up thinking hold short of 22L instead of 22R.” (ACN 1426542 Excerpt)
Perilog

- Text mining tool that measures the degree of contextual association of large numbers of words as pairs in narratives or other text to produce models that capture the contextual structure. It compares models to measure their degree of similarity.
- Patented by NASA, Dr. McGreevy

Search by Example

- Narratives of all 770 Runway Incursion events were analyzed to identify one as the best representative record
- Record 1343844 was retrieved as the highest relevance ranked report
- This record contains five total reporters, one Tower Controller and the Flight Crew involved in a runway incursion related ground conflict
BUSINESS JET THAT HAD JUST WITHHOLD DEP CLRNC UNTIL EXITING COMPLETE. WE WERE CLRED TO HOLD IN BTWN A SMALL DEP % /Users/asrs100/binqp/list.narrs3 -h px.temp rank.temp 20 rightRMV 4
executed in the directory /private/tmp

BUSINESS DECIDED THAT AND IT WAS DIFFICULT TO DETERMINE. IT WAS OBVIOUS THE ACFT WAS NOT IN OUR FLT PATH. WE TOLD UNABLE AND CONTINUED THE TKOF AND SUBSEQUENT LEG UNEVENTFULLY. THIS IS A VERY BUSY ENVIRONMENT AND I BELIEVE ACFT X WAS CONFUSED ABOUT THE TAXI INSTRUCTIONS AND JUST EXITED RWY BUT DIDN'T ROLL FAR ENOUGH FOR HIS TAIL TO CLR THE HOLD SHORT LINE, OR AT LEAST THAT IS WHAT TWR BELIEVED. NEITHER TWR NOR US ANTICIPATED THIS AND TWR 'S DECISION TO CANCEL OUR CLRNC WAS MADE TOO LATE. WE WERE GIVEN "LINE UP AND WAIT, RWY 22L" FROM TWR AS THE ACFT WE TOOK THE RWY. AS THE PRECEDING ACFT TURNED TO CLR THE RWY, BUT DELAY DUE TO AN ACFT ON FINAL. WE VERIFIED THAT THE THE RWY AND BEGAN OUR TKOF ROLL. AT ABOUT 100 KIAS ( V1 WAS 114 KIAS ), TWR CANCELED OUR TKOF CLRNC. I THINK IT WAS BECAUSE THE PRECEDING ACFT HAD CLR ED THE RWY, BUT STOPPED BEFORE COMPLETELY XING THE HOLD SHORT LINE (" COMPLETELY CLR OF THE ACTIVE RWY "). AT THAT SPD, WE CHOSE TO CONTINUE THE TKOF BECAUSE THE PRECEDING ACFT WAS NOT A SAFETY FACTOR COMPARED TO THE RISKS INVOLVED WITH A HIGH SPD ABORT. I TOLD TWR THAT WE WERE CONTINUING AT THAT POINT " TOO FAST " TO STOP BY THE TIME WE HAD MADE THE DECISION. THE ACFT WAS NOT A FACTOR FOR US ALTHOUGH HE IMPROPERLY CLR ED THE ACTIVE RWY (STOPPING THE TAXI INSTRUCTIONS , I ASSUME). WE CONTINUED THE TKOF UNEVENTFULLY AND TWR DID NOT DO ANYTHING ELSE. REMAINDER OF THE FLT WAS ALSO UNEVENTFUL. TWR SHOULD ENSURE THE ACFT IS CLR OF THE HOLD SHORT LINE BEFORE GIVING TKOF CLRNC. WE COULD HAVE COMPLETED A NORMAL APCH AND LNDG TO RWY 22L AT HED INSTRUCTIONS TO TAXI KILO, VICTOR, CROSS THE ACFT TO A SAFE TAXI SPD. APCHING TXWY KILO AND TWR GAVE THE ACFT THE HOLD SHORT LINE BECAUSE THE PRECEDING ACFT HAD NOT COMPLETED THEIR INSTRUCTIONS AND WANTED US TO USE VICTOR, THE NEXT EXIT FROM RWY 22L AFTER KILO, TO CLR THE RWY.
EXITING THE RWY. WE WERE UNAWARE AT THE TIME AN ACFT WAS OCCURRING, I COULD HAVE WANTED US TO USE VICTOR INSTEAD OF KILO TO ATC SAID OUR CALL SIGN AND VICTOR IN THE XMISSION, AT THAT POINT WE WERE UNSURE IF HE DISCONTINUE ITS.

RWY OPS STOP AND WE HAD ALREADY BEGUN TO UNFORTUNATELY A NEW PREVIOUS CLRNC TO EXIT OFF THE RWY. SUBSEQUENT RADIO CALL PRIOR TO EXITING THE RWY THE CALL ELICITED SOME CONFUSION. ATC SAID OUR CALL SIGN AND VICTOR IN THE XMISSION, AT THAT POINT WE WERE UNSURE IF HE WANTED US TO USE VICTOR INSTEAD OF KILO TO CLR THE RWY. I WAS UNAWARE THAT ATC CLRED ACFT X BEHIND US TO TKOF PRIOR TO US EXITING THE RWY. REVIEWING THE OCCURRENCE, I COULD HAVE CLRED THE RWY BASED ON THE INITIAL INSTRUCTIONS IN ORDER TO PREVENT AND THEN QUERIED ATC. HOWEVER I THEN COULD HAVE POTENTIALLY VIOLATED A REVISED ATC CLRC IF THEY DID IN FACT WANT US TO CLR THE RWY AT A DIFFERENT TXWY. WE WERE UNAWARE AT THE TIME AN ACFT WAS CLRED FOR TKOF BEHIND US ON THE RWY WE WERE EXITING. THE AIM GUIDES PLTS TO TAXI CLR OF THE RWY AT THE FIRST AVAILABLE TXWY OR AS DIRECTED BY ATC. IN THIS SIT WE BEGAN TO EXIT AS DIRECTED BY ATC, BUT THE SECOND RADIO CALL FROM ATC WITH OUR CALL SIGN CAUSED CONFUSION AS IT CONTAINED THE NAME OF THE NEXT TXWY EXIT FROM RWY 22L. I WOULD SUGGEST ATC, AFTER THEY INITIALLY PROVIDE INSTRUCTIONS ON RWY CLRING, TO WAIT TO CALL AN ACFT WITH FURTHER INSTRUCTION UNTIL THEY ARE CLR OF THE RWY UNLESS THEY ARE AMENDING THE INITIAL INSTRUCTIONS. ACFT WAS GIVEN CLRCN TO LND ON RWY 22L AT MDW. AFTER LNDG AND DURING ROLLOUT TWR INSTRUCTED US TO CLR ON TXWY K, V, AND HOLD SHORT OF RWY 22R ON V. THIS IS WHAT WE HAD BRIEFED DURING APCH BRIEF PRIOR TO ARR AND WE WERE READY FOR THIS CLRCN. UPON EXITING RWY 22L ONTO RWY K, TWR AGAIN CALLED US AND SAID "EXIT V", SO OUR FIRST REACTION KNOWING THAT TXWY V WAS THE NEXT EXIT OFF THE RWY (FURTHER DOWN) WAS TO STOP THE ACFT AND QUERY THE TWR TO CONFIRM THAT HE WANTED US TO CONTINUE DOWN TO V. AT THIS POINT HE TOLD ACFT X "CANCE TABLE CLRCN", AT WHICH POINT THE ACFT X RESPONDED, "TOO LATE WE ARE ALREADY ROLLING", REALIZING THE SIT, WE CONTINUED ON TXWY K TO TXWY V AS INITIALLY INSTRUCTED TO HOLD SHORT OF RWY 22R. WE WERE GIVEN CLRCN TO CROSS RWY 22R, CONTACT GC ON TXWY W INTO [FBO]. AFTER POST FLT DUTIES WERE COMPLETE, I CONTACTED GC ON THE RADIO AND WANTED TO SPEAK WITH THEM ABOUT WHAT JUST HAPPENED. AT THAT DAY / TIME, THE TWR SAID "PLEASE EXPEDITE CLRING THE RWY NEXT TIME". I ASKED IF ANYTHING FURTHER NEEDED TO BE PASSED ON, AND NOTHING WAS MENTIONED. AT THAT MOMENT I THOUGHT EVERYTHING WAS OKAY, AND NOTHING FURTHER NEEDED TO BE ACCOMPLISHED. IT WASN'T UNTIL DATE AND TIME REDACTED, WHERE I LEARNED THE POSSIBILITY OF AN ACFT / RWY INCURSION POSSIBLY TOOK PLACE FROM THIS EVENT AND WE (AIRCrew) SHOULD TAKE ACTION WITH A RPT. AS THE PLT MONITORING (PM) ON THIS FLT LEG, THE PRIMARY REASON THIS OCCURRED IS TWOFOLD: POOR PHRASEOLOGY BY THE TWR, AND POOR WORDING TO EMPHASIZE WHAT HE WANTED US TO DO. HAD HE CHOSE TO SAY: "ACFT X EXPEDITE ONTO TXWY K FOR DEPARTING ACFT", WE WOULD HAVE EASILY KNOWN WHAT TO DO. INSTEAD, THE TWR TOLD US TO "EXIT ONTO TXWY V", IN ESSENCE GIVING A NEW TAXI CLRCN. IF YOU TAKE THIS NEW CLRCN DIRECTLY, IT MEANS CANCEL YOUR PREVIOUS CLRCN TO EXIT ON TXWY K, AND CONTINUE DOWN THE RWY AND EXIT ON TO TXWY V. UNFORTUNATELY, WE HAD ALREADY BEGUN TO EXIT THE RWY ONTO K, THUS CAUSING US TO STOP AND MOMENTARILY CLARIFY WITH TWR THAT THIS IS TRUE WHAT THEY WANT US TO DO."EXIT OFF RWY 22L ON V?" WHEN DAYS OCCUR WITH STRONG WINDS, IT BOILS DOWN TO SINGLE RWY OPS FOR MOST OF THE ACFT ARRIVING AT MDW. THE SHORTER RWYS (I.E. 22R) WILL NOT WORK WITH GUSTY WINDS FOR MOST OF THE TURBOJET ACFT ARRIVING / DEPARTING. POTENTIAL INHERENT PRESSURES (MGMNT, SELF - DERIVED), WHATEVER THE CASE, TO CONTINUE...
ASRS Runway Incursion Incidents - Summary

- ASRS has received an increase in Runway Incursion (RI) reports since 2001. However, reporting has leveled off in the past 5 years.

- General Aviation Flight Crew (GA-FLC) account for 40% of all RI report submissions since 2012; followed by Air Carrier pilots (ACR) with 36%.

- Primary analysis data (770 incidents):
  - A total of 636 (90%) of events occurred at Towered Airports.
  - The highest concurrent anomaly found was ATC issues with 352 (45.7%) of incidents, followed by Ground Conflict - Less Severe with 213 (26.6%) and Ground Conflict – Critical with 125 (16.2%) incidents.
  - Human Factors was the most frequently coded contributing factor with 671 (87.1%) incidents.
  - Situational Awareness, Communication Breakdown, Confusion and Distraction were the most frequently coded type of Human Factors.
  - Additional screening of specific Human Factors revealed typical explanations or provided inferences “why” these human factors occur in their event.
  - Explanations included:
    - Communication Breakdown – Expectation Bias, Frequency Congestion, Readback/Hearback.
    - Confusion – Airport Layout, Airport Markings, Similar Callsign.
ASRS Runway Incursion Incident Records

ASRS Website – Runway Incursion Research and Structured Callback Studies

ASRS captures confidential reports, analyzes the resulting aviation safety data, and disseminates vital information to the aviation community.

CALLBACK

Receive FREE monthly newsletter by email. (Read Policy)

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Metroplex Mystique
June 2017, Issue 449

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Meteorological & AIS Data Link Services & Applications Study

View Program Briefing
Learn more about ASRS such as report processing and reporting metrics.

http://asrs.arc.nasa.gov/
ASRS Runway Incursion Projects, Studies and Articles

- Compendium of Airport Surface Movement Event Transgressions for 75 US Airports
  
- Runway Transgressions at Non-Towered and Tower-Closed Airports
  
- An Analysis of Airport Surface Movement Event Transgressions
  Completed at the request the FAA Office of Runway Safety, ATO-S
  Hard copy only

- Structured Callback Study requested by the FAA
  https://asrs.arc.nasa.gov/docs/rs/61_Runway_Transgressions_NonTowered.pdf

- CALLBACK Article Issue 418
  Crossing the Line: Runway Incursions
  https://asrs.arc.nasa.gov/docs/cb/cb_418.pdf
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