

Data Analysis of ASRS Runway Incursion Incident Reports

NTSB Runway Incursion Forum, Office of Aviation Safety

Capt. Gary Brauch ASRS Expert Analyst (Metis Technology)

Linda J. Connell

NASA ASRS Program Director

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AVIATION SAFETY REPORTING SYSTEM



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%)



Total Intake
– Linear Trend (Total Intake)

Runway Incursions (% of Total Intake)

- - - Linear Trend (Runway Incursions (% of Total Intake))

*2017 data was projected based on reports received through August 16th. Source: ASRS Screening Data Set (100%)





Reporter Type (Affiliation) and Year

n = 11,168

AFFIL	2012	2013	2014	2015	2016	2017*	Grand Total	Count of Reports
GA-FLC	813	746	825	795	837	542	4,558	1 837
ACR-FLC	609	694	790	755	708	468	4,024	
ATC	327	249	341	347	346	276	1,886	
ATX-FLC	89	88	108	122	106	83	596	
Other	11	5	11	14	8	5	54	
Maintenance	6	9	5	8	10	1	39	
Ground	3	1	0	0	3	1	8	
Dispatch	0	0	1	2	0	0	3	
Grand Total	1,858	1,792	2,081	2,043	2,018	1,376	11,168	





Top 15 Concurrent Anomalies





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

FACID	2012	2013	2014	2015	2016	2017*	Grand Total	Count of Reports
LAX	42	45	62	23	64	26	262	4 64
MDW	39	33	53	47	44	14	230	
SFO	31	20	52	39	41	26	209	
ORD	29	29	37	59	32	23	209	
DAL	16	27	34	31	53	25	186	
MIA	12	33	41	27	44	28	185	
BOS	36	27	33	21	30	23	170	
DFW	16	20	26	41	28	12	143	
DCA	12	23	17	30	35	19	136	
CLT	18	16	21	33	18	30	136	
ATL	16	15	21	27	16	24	119	
HOU	22	19	14	16	30	13	114	
PHL	15	18	26	20	18	16	113	
EWR	12	20	22	21	22	13	110	
LAS	12	15	13	33	17	12	102	
PIT	15	15	9	30	22	9	100	
LGA	24	18	18	12	4	14	90	
HNL	15	7	23	25	12	7	89	
DEN	14	14	18	8	23	11	88	
SEA	13	9	15	17	23	6	83	n = 11,168
Grand Total	409	423	555	560	576	351	2,874	



*2017 data complete through August 16 $^{\text{th}}$.

Source: ASRS Screening Data Set (100%)

- 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.

Top 15 Concurrent Anomalies





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Contributing Factors





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Concurrent Human Factors





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ASRS Runway Incursion Incident Records 50 Most Recent "Communication Breakdown" Records

<u>Communication Breakdown</u> – 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

"...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)

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ASRS Runway Incursion Incident Records 50 Most Recent Confusion Records

<u>Confusion</u> 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

"...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)



ASRS Runway Incursion Incident Records 50 Most Recent Distraction Records

<u>Distraction</u> – 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

"...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 nonstandard taxi to 22L and ending up thinking hold short of 22L instead of 22R." (ACN 1426542 Excerpt)



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ASRS Runway Incursion Incident Records Perilog – NASA Text Mining

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





Relevant documents, with shared relations highlighted

These narratives were found by QUORUM Perilog to be relevant with respect to the search request criteria. The highlighted words in each narrative are those contained in relations that appear in both the document model of the narrative and in the relations of the query model. This HTML file was generated by the command: % /Users/asrs100/binqp/list.narrs3 -h px.temp rank.temp 20 rightRMV 4 executed in the directory /private/tmp

Document identification number: 1343844 relevance rank: 1

Expectation

DEP CLRNC UNTIL EXITING COMPLETE . WE WERE CLRED [TO] HOLD IN BTWN A SMALL HAD JUST LANDED ON RWY 22L AND AN ACFT ON THREE - MI FINAL, TWR TOLD US TO BE READY . AS ACFT X FINISHED CLRING THE RWY , WE WERE CLRED FOR TKOF . AS WE BEGAN OUR TKOF LL , TWR WAS CONTINUING TO COMMUNICATE TAXI INSTRUCTIONS WITH THE PRECEDING ACFT X . AT Expedite PROX 100-105 KTS , TWR CANCELED OUR TKOF CLRNC . AT THAT SPD , ABOUT 10 KTS SHORT OF V1 , I ONTINUING OUR TKOF WOULD BE THE SAFEST COURSE OF ACTION . THE PRECEDING HAD CLRED THE RWY, BUT HAD MAYBE NOT COMPLETELY CLRED THE HOLD SHORT LINE 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 Confused RONMENT AND I *BELIEVE ACFT* X WAS *CONFUSED* ABOUT THE *TAXI INSTRUCTIONS* AND JUST *EXITED* BUT DIDN'T ROLL FAR ENOUGH FOR HIS TAIL TO CLR THE HOLD SHORT LINE, OR AT LEAST THAT TWR BELIEVED . NEITHER TWR NOR US ANTICIPATED THIS AND TWR 'S DECISION TO CANCEL OUR WERE GIVEN " LINE UP AND WAIT, RWY 22L " FROM TWR AS THE ACFT

GIVEN TO ACFT Y WITH EXPECTATION OF ACFT X EXITING . [RECOMMENDATION IS TO]

WE TOOK THE RWY . AS THE *PRECEDING ACFT* TURNED TO *CLR* THE *RWY* , UT *DELAY* DUE TO AN *ACFT* ON *FINAL* . WE VERIFIED THAT THE 'HE *RWY* AND BEGAN OUR *TKOF ROLL* . AT ABOUT 100 KIAS (V1 WAS 114 Improperly Cleared

Unclear

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 CLRED THE ACTIVE RWY (STOPPING

TWK CANCELED OUK TKOF CLRNC . I THINK IT WAS BECAUSE THE PRECEDING ACFT HAD CLRED

TAXI INSTRUCTIONS, I ASSUME). WE CONTINUED THE TKOF UNEVENTFULLY AND TWR DID THING ELSE . REMAINDER OF THE FLT WAS ALSO *UNEVENTFUL* . *TWR* SHOULD *ENSURE* THE Phraseology OF THE HOLD SHORT LINE BEFORE GIVING TKOF CLRNC . WE COULD HAVE JRING THAT HE WAS , BUT WE CANNOT TELL IF HE 'S ACTUALLY *CLR* OF THE *LINE* FROM THE END OF THE RWY . MOST IMPORTANTLY , THE PLT OF THE PRECEDING ACFT NEEDS TO MAKE

Single Runway Operations DINSTR

ETELY CLRING THE ACTIVE RWY BEFORE ETED A NORMAL APCH AND *LNDG* TO *RWY 22L* AT TO TAXI KILO, VICTOR, CROSS TO A SAFE TAXI SPD . APCHING TXWY K

I BEGAN A RIGHT TURN TO EXIT THE RWY . UPON INITIATING THE TURN ON KILO WE HEARD ATC CALL ' ACFT X VICTOR " AND NOTHING ELSE . I SLOWED THE ACFT TO A STOP AND THE PNF (PNF) IMMEDIATELY QUERIED ATC TO CONFIRM INSTRUCTIONS . WE WERE CONCERNED ATC MAY HAVE CHANGED THEIR INSTRUCTIONS AND WANTED US TO USE VICTOR, THE NEXT EXIT FROM RWY 22L AFTER KILO, TO CLR THE *RWY* ...

DISCONTINUE ITS TKOF . UPON HEARING THAT XMISSION I TAXIED THE ACFT CLR OF THE RWY TO	Relations shared by	y narrative of report	number 1342	3844 a	and query
AVOID ANY CONFLICT . AFTER CLRING ATC ISSUED OUR ACFT TAXI INSTRUCTION TO TAXI KILO ,	model, 'px.temp'				1 0
VICTOR , CROSS 22L TO [FBO] . THE FLT CONTINUE WITHOUT FURTHER ISSUE . I FEEL THE ISSUE					
AROSE FROM ATC XMITTING A SECOND RADIO CALL TO OUR ACFT THAT WAS UNCLR AND					
SEEMINGLY INCOMPLETE PRIOR TO OUR CLRING THE RWY. WE CLRLY UNDERSTOOD AND BEGAN					
TO FOLLOW THE INITIAL INSTRUCTIONS TO CLR AT KILO , HOWEVER WHEN WE RECEIVED A					
SUBSEQUENT RADIO CALL PRIOR TO EXITING THE RWY THE CALL ELICITED SOME CONFUSION .	A: right RMV	from highlight	ing/crite	ria	model
ATC SAID OUR CALL SIGN AND VICTOR IN THE XMISSION , AT THAT POINT WE WERE UNSURE IF HE	B: right RMV	from narrative			
WANTED US TO USE VICTOR INSTEAD OF KILO TO CLR THE RWY . I WAS UNAWARE THAT ATC	x: scale fact	or			
CLRED ACFT X BEHIND US TO TKOF PRIOR TO US EXITING THE RWY. REVIEWING THE	C: A * B * x				
OCCURRENCE, I COULD HAVE CLRED THE RWY BASED ON THE INITIAL INSTRUCTIONS IN ORDER	wordl	word2	A	В	C
TO PREVENT AND THEN OUERIED ATC. HOWEVER I THEN COULD HAVE POTENTIALLY VIOLATED A	HOLD	SHORT	397500	18	14310000
REVISED ATC CLRNC IF THEY DID IN FACT WANT US TO CLR THE RWY AT A DIFFERENT TXWY . WE	SHORT	LINE	160200	12	3844800
WERE UNAWARE AT THE TIME AN ACET WAS CLRED FOR TKOF BEHIND US ON THE RWY WE WERE	HOLD	LINE	137700	8	2203200
EXITING THE AIM GUIDES PLTS TO TAXI CLR OF THE RWY AT THE FIRST AVAILABLE TXWY OR AS	TAXI	INSTRUCTIONS	45900	12	1101600
DIRECTED BY ATC IN THIS SIT WE BEGAN TO EXIT AS DIRECTED BY ATC BUT THE SECOND RADIO	TKOF	CLRNC	42500	12	1020000
CALL FROM ATC WITH OUR CALL SIGN CAUSED CONFUSION AS IT CONTAINED THE NAME OF THE	CROSS	RWY	75500	6	906000
NEXT TXWY FXIT FROM RWY 221. I WOULD SUGGEST ATC AFTER THEY INITIALLY PROVIDE	RWY	22L	17400	24	835200
INSTRUCTIONS ON RWY CI RING. TO WAIT TO CALL AN ACET WITH FURTHER INSTRUCTION UNTIL	ACTIVE	RWY	40400	9	727200
THEY ARE CLR OF THE RWY UNLESS THEY ARE AMENDING THE INITIAL INSTRUCTIONS ACET WAS	CLR	RWY	23500	14	658000
GIVEN CLENCT OLIND ON RWY 22L AT MOW AFTER LINDG AND DURING ROLLOUT TWR	SHORT	RWY	79500	4	636000
INSTRUCTED US TO CLR ON TYWY K V AND HOLD SHORT OF RWY 22R ON V THIS IS WHAT WE	EXIT	RWY	16200	11	356400
HAD RRIEFED DURING ARCH RRIEF PRIOR TO ARR AND WE WERE READY FOR THIS IS WHAT WE	TKOF	ROLL	29700	6	356400
EXITING PWY 221 ONTO TYWY K TWP AGAIN CALLED US AND SAID "EXIT V." SO, OUP FIRST	CLRED	TKOF	32200	5	322000
REACTION KNOWING THAT TYWY V WAS THE NEXT EXIT OFF THE PWV (FURTHER DOWN) WAS TO	CLRED	RWY	19100	7	267400
STOP THE ACET AND OUERV THE TWR TO CONFIRM THAT HE WANTED US TO CONTINUE DOWN TO	RWY	22R	10100	12	242400
V AT THIS DOINT HE TOLD ACET Y "CANCEL TKOF CLONC" AT WHICH DOINT THE ACET Y	TWR	TOLD	16500	б	198000
PESPONDED "TOO I ATE WE ADE ALDEADY POLLING" DEALIZING THE SIT. WE CONTINUED ON	CLRED	ACFT	32100	3	192600
TYWY K TO TYWY V AS INITIALLY INSTRUCTED TO HOLD SHOPT OF PWV 22P WE WERE GIVEN	RWY	INCURSION	27800	3	166800
CLENC TO CROSS PWY 22P CONTACT OF ON TYWY W INTO [ERO] A FTED DOST ELT DUTIES WEDE	TAXI	CLRNC	24500	3	147000
COMPLETE I CONTACTED CC ON THE PADIO AND WANTED TO SPEAK WITH THEM ABOUT WHAT	TWR	CLRED	21800	3	130800
UST HADDENED AT THAT DAY / TIME THE TWO SAID " DI FASE EXDEDITE CI DINC THE DWY NEYT	PRECEDING	ACFT	3000	21	126000
TIME " I ASKED IE ANVTUING EUDTUED NEEDED TO BE DASSED ON AND NOTHING WAS	EXITING	RWY	8400	7	117600
MENTIONED AT THAT MOMENT I THOUGHT EVED VTHING WAS OKAY AND NOTHING EIDTHED	ACFT	CLR	7300	8	116800
NEEDED TO DE ACCOMDI ISHED IT WASN'T INTIL I DATE AND TIME DEDACTED I WHEDE I	LNDG	RWY	23600	2	94400
I EADNED THE DOSSIDILITY OF AN ACET / DWY INCLUSION DOSSIDILY TOOK DIACE FOOM THIS	TOLD	ACFT	15400	3	92400
EVENT AND WE (ADCDEW) SHOULD TAKE ACTION WITH A DT. AS THE DIT MONITODING (DM)	CLRING	RWY	6000	7	84000
EVENT AND WE (AIRCREW) SHOULD TAKE ACTION WITH A RPT. AS THE PLT MONITORING (PM)	LND	RWY	19300	2	77200
UN THIS FLI LEU, THE PRIMART REASON THIS OCCURRED IS TWOFOLD : POOR PHRASEOLOGI BY	ACFT	FINAL	19100	2	76400
THE I W R , AND POOR WORDING TO EMPHASIZE WHAT HE WANTED US TO DO. HAD HE CHOSE TO	LANDED	RMA	18200	2	72800
SAY : " ACFT X EXPEDITE ONTO TXWY K FOR DEPARTING ACFT ", WE WOULD HAVE EASILY			10200	2	72000
KNOWN WHAT TO DO. INSTEAD, THE TWR TOLD US TO "EXIT ONTO TXWY V", IN ESSENCE GIVING					
A NEW TAXI CLRNC . IF YOU TAKE THIS NEW CLRNC DIRECTLY , IT MEANS CANCEL YOUR					
PREVIOUS CLRNC TO EXIT ON TXWY K, AND CONTINUE DOWN THE RWY AND EXIT ONTO TXWY V.		List Conti	nues		
UNFORTUNATELY, WE HAD ALREADY BEGUN TO EXIT THE RWY ONTO K, THUS CAUSING US TO					
STOP AND MOMENTARILY CLARIFY WITH TWR THAT THIS IS TRULY 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 <i>TURBOJET ACFT</i> 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 <u>ATC issues</u> with 352 (45.7%) of incidents, followed by <u>Ground Conflict - Less Severe</u> with 213 (26.6%) and <u>Ground Conflict – Critical</u> with 125 (16.2%) incidents
 - <u>Human Factors</u> was the most frequently coded contributing factor with 671 (87.1%) incidents
 - <u>Situational Awareness</u>, <u>Communication Breakdown</u>, <u>Confusion</u> and <u>Distraction</u> were the most frequently coded type of Human Factors
 - Additional screening of specific Human Factors revealed typical explainations or provided inferences "why" these human factors occur in their event
 - Explanations included:
 - \pm <u>Communication Breakdown</u> Expectation Bias, Frequency Congestion, Readback/Hearback.
 - [±] <u>Confusion</u> Airport Layout, Airport Markings, Similar Callsign.



ASRS Website – Runway Incursion Research and Structured Callback Studies



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Metroplex Mystique June 2017, Issue 449

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http://asrs.arc.nasa.gov/





ASRS Website – Runway Incursion Research and Structured Callback Studies

ASRS Runway Incursion Projects, Studies and Articles



An Analysis of Airport Surface **Movement Event Transgressions**

Completed at the request the FAA Office of Runway Safety, ATO-S Hard copy only

Runway Transgressions at Non-Towered and **Tower-Closed Airports**



Structured Callback Study requested by the FAA

https://asrs.arc.nasa.gov/docs/rs/61_Runway_ Transgressions NonTowered.pdf



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Eighty Degree Error



https://asrs.arc.nasa.gov/docs/cb/cb 418.pdf





CONTACT INFO

Linda Connell, NASA ASRS Program Director Linda.J.Connell@nasa.gov (408) 541-2827

Dennis Doyle ASRS Program Manager (BAH) <u>Dennis.J.Doyle@nasa.gov</u> (408) 541-2831

Capt. Gary Brauch ASRS Expert Analyst (Metis) <u>Gary.J.Brauch@nasa.gov</u> (408) 541-2869



