Runway Transgressions at Non-Towered and Tower-Closed Airports

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Aviation Safety Reporting System
625 Ellis St. Suite 305 Mountain View California 94043

NASA ASRS (Pub. 60)

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EXECUTIVE SUMMARY

The FAA asked the Aviation Safety Reporting System (ASRS) to undertake a "structured callback" study on runway transgression incidents recently reported to the program as having occurred at a non-Towered or Tower-closed airport. A structured callback study is a detailed telephone interview based on a standardized questionnaire. The purpose of the study was to expand the FAA's knowledge of the factors associated with non-Towered airport runway transgressions. The FAA also requested a similar study on runway transgression incidents at Towered airports. A separate document reports the findings from that study.

The ASRS interviewed 51 pilots between September 2000 and August 2001 whose reported incidents met the study criteria for aircraft/aircraft or aircraft/vehicle transgressions. No non-Towered aircraft/pedestrian events were reported during this period. Twenty-two of the respondents were pilots of single-crew aircraft and fourteen were pilots of multi-crew aircraft. The majority of respondents represented General Aviation operators, with air carrier, air taxi, commuter, and corporate operators also included. ASRS subsequently analyzed the study data and developed baseline profiles from the ASRS database.

ASRS Database Baseline Data Findings

Approximately one non-Towered runway transgression event is reported to ASRS for every six events at a Towered airport. ASRS received 627 total reports describing runway transgression events at non-Towered and Tower-closed airports between 1990-2001. Over this 11-year period, the number of ASRS database reports of transgression incidents at airports without an operating Control Tower decreased slightly, in spite of an increase in total reporting to ASRS.

ASRS Structured Callback Study Findings

Respondents were generally experienced pilots who were familiar with the airport at which the transgression occurred. The average and median flight hours for the reporting group were 3,351 and 1,740 hours, respectively. More than 70 percent of the reporters had flown into the airport at which the transgression occurred 5 times or more, and 51 percent had done so within a week prior to the incident. A large majority (82 percent) of respondents described the airport activity level as being "low" to "moderate" at the time of their incident.

Each respondent was asked to assess the severity of the reported transgression event on a scale of 1 to 5, with 1 being "Not Hazardous" and 5 being "Very Hazardous." Seventy-two percent of the study respondents evaluated their incidents in the 1-3 severity range ("low" to "moderate" severity), while the remaining rated their events in the 4-5 severity range (higher severity). This distribution of responses is identical to that for the Towered runway transgression structured callback study.

Respondents were asked what sources alerted them to the runway transgression. Information received by radio (UNICOM, CTAF, etc.) provided an alert in 26 percent of the incidents. Communication from other pilots, and pilots' visual observations were additional alerting sources. In 35 percent of incidents, the pilot was not alerted to the conflict by any source.

More than half of the non-Towered runway transgressions occurred at airports with an intersecting runway or parallel/intersecting runway configuration. Almost three-fourths of the non-Towered incidents involved traffic operations at airports where a single runway was in use, generally because of wind direction or runway use by other traffic. Wind direction was twice as likely to influence pilots' choice of a runway for takeoff or landing as traffic flow.

A geographical or topographical obstruction to pilots' line of sight was a factor in almost 40 percent of the runway transgression events. Runway slope, trees, and rising terrain were the most frequently cited obstructions to vision.

Training activity was taking place in 25 percent of the non-Towered transgression incidents. This most frequently involved training for a rating or proficiency practice.

A large majority of the pilots interviewed felt comfortable with non-Towered airport communication procedures, but alleged that other pilots did not communicate their positions clearly (in 53 percent of incidents) or seemed confused about the proper frequency (12 percent of incidents). Lack of situational awareness was the factor most frequently identified by pilots as contributing to the non-Towered runway transgression event.

Respondents suggested that new technology could help alleviate pilot problems commonly experienced at non-Towered airports. These problems include difficulty identifying the active runway and inability to detect other aircraft on runways with pronounced slopes. The pilots interviewed also suggested practical expedients, such as installing signs at runway ends specifying the CTAF for the airport and the preferred runway.

INTRODUCTION

Since 1990 the FAA has initiated a series of action plans and initiatives to address the problem of runway safety, especially the problem of runway transgressions. Simply stated, a runway transgression occurs when an aircraft, vehicle, or pedestrian encroaches on an active runway while it is being used by another aircraft to land or take off.

The analysis of runway transgression data is a necessary step towards developing approaches that will identify emerging runway safety issues and aid the development of timely and cost-effective prevention measures. The FAA has gathered extensive information on the types and severity of runway transgressions at Towered airports,[1] but has limited access to information on transgression events at non-Towered and Tower-closed airports.

In the light of this information gap, the FAA asked NASA's Aviation Safety Reporting System (ASRS) to undertake a "structured callback" study of runway transgression events at non-Towered and Tower-closed airports. An ASRS structured callback study involves the conduct of detailed telephone interviews by expert aviation analysts with individuals who have submitted a relevant incident report to ASRS and agree to answer supplemental questions about the incident. The information collected is treated confidentially, and any details that can identify an individual or organization are removed prior to data analysis.

Structured callback studies are an ASRS research tool for identifying and exploring the common factors that underlie a group of incidents. Through the telephone callback mechanism it is possible to obtain enhanced information about the factual details surrounding an incident, as well as subjective information that might otherwise remain unknown, such as reporters' decisions, practices and attitudes.

The ASRS expert analyst group consists of experienced pilots and air traffic controllers. Their years of experience are measured in decades and cover the full spectrum of aviation activity: air carrier, military, and general aviation; and Air Traffic Control in Towers, TRACONS, Centers, and Military Facilities.

DEFINITIONS

Runway Transgression

The FAA and ASRS definitions of a runway transgression reflect the unique missions of these organizations.

FAA Runway safety is managed according to rigorous protocols that pilots and air traffic controllers use to control aircraft on runways at all times. The FAA definition of a runway transgression supports the agency's safety management and enforcement goals. A runway transgression is defined by the FAA as follows:

> **"Any occurrence at an airport involving an aircraft, vehicle, or person on the ground that creates a collision hazard or results in a loss of required separation with an aircraft taking off, intending to take off, landing, or intending to land."** [2]

ASRS The ASRS focuses on the collection and analysis of voluntarily reported operational data. The data collected are used to identify deficiencies in the National Aviation System and examine human performance within the aviation system. The ASRS's interest in the events and conditions that lead to human performance decrements are reflected in its definition of a runway transgression:

> **"Any erroneous or improper occupation of a runway or its immediate environs by an aircraft or other vehicle so as to pose a potential collision hazard to other aircraft that could be using the runway, even if no such other aircraft are actually present."**

In this study, the FAA Office of Runway Safety concurred with the application of the ASRS definition of a runway transgression as the basis for incident report selection.

1 *FAA Runway Safety Report: Runway Transgression Severity Trends at Towered Airports in the United States*, 1997-2000. Federal Aviation Administration Office of Runway Safety, June 2001.
2 *FAA Runway Safety Report, p.5.*

Conflicts and NMACs

References to conflicts and NMACs in this report are based on the following criteria:

Conflict/Ground Critical: Severe collision hazard exists as evidenced by a) emergency evasive action, or b) flight crew statement. Where two aircraft are involved (vs. a ground vehicle or pedestrian), one aircraft may be airborne.

Conflict/Ground Less Severe: A collision hazard exists but the conflict could be resolved with less than immediate reaction.

Conflict/Airborne Less Severe: An estimated conflict of 500 or more feet separation both horizontally and vertically between two or more aircraft.

Near Mid-Air Collision (NMAC): An estimated conflict of less than 500 feet separation both horizontally and vertically between two or more aircraft. The ASRS and FAA definitions of an NMAC are identical.

OBJECTIVES

This study has three purposes:

- Develop baseline ASRS database profiles of runway transgression frequency at non-Towered airports.
- Improve the understanding of event dynamics and factors underlying runway transgressions that occur at Non-Towered and Tower-closed airports.
- Present findings in a manner that supports ongoing FAA efforts to address the causal factors of runway transgressions and reduce the risk of pilot operations at non-Towered and Tower-closed airports.

APPROACH

Scope

To be included in the study, an incident was required to meet the following criteria:

- Occurred at a non-Towered or Tower-closed airport;
- Involved an aircraft (or vehicle) that entered, or crossed the hold line of, an active or occupied runway;
- Involved a reporter willing to participate in the study.

The FAA also expressed an interest in reports deemed to be rich in descriptive detail and involving potential criticality. With these additional criteria in mind, ASRS analysts attempted to select reports that fully met both sets of criteria. As a result of the report selection process, the study set of incidents may not be representative of all non-Towered and Tower-closed runway transgressions received during this time period.

Structured Callback Instrument

In the late fall of 2000 ASRS began identifying candidate reports from its incoming report flow and developing a questionnaire for the conduct of "structured callback" telephone interviews. A FAA document detailing the Airport Surface Movement Area (SMA) hazard classification system was used as a resource for development of questions pertaining to topographical and geographical hazards, weather factors, unsafe acts, equipment problems, and procedural issues.[3]

During the questionnaire development phase, ASRS also undertook significant outreach efforts to obtain aviation community input. Representatives of organizations including the Airplane Owners and Pilot Association (AOPA), National Business Aircraft Association (NBAA), National Air Traffic Controllers Association (NATCA), Air Line Pilots Association (ALPA), Regional Airlines Association (RAA), the FAA Office of System Safety, and other aviation and government groups were contacted and asked to review and comment on successive callback questionnaire drafts. These aviation organizations were further requested to disseminate ASRS's request for input to their members and constituents. The collective suggestions of these aviation industry groups were incorporated in the final callback questionnaire. Appendix A contains the callback questionnaire form used for this study.

3 *"Airport Surface Movement Area Data Analysis* (v.2)*,"* Federal Aviation Administration, Office of System Safety, June 2001 (Slide Presentation).

Data

Over the six-month period from September 2000 to August 2001, fifty-one qualifying incident reports were selected as the basis for callback interviews. Forty-nine incidents involved aircraft-to-aircraft transgressions and two incidents involved aircraft-to-vehicle transgressions. ASRS was not able to contact some reporters who had submitted qualifying incidents. However, all reporters that ASRS succeeded in contacting agreed to participate. The reputation of the ASRS in protecting reporter confidentiality was the key factor in this high response rate.

ASRS analysts manually recorded information on question forms as they conducted the telephone interviews with reporters. The data from each structured callback interview was entered into a database for further tabulation and analysis. Appendix B contains a comprehensive data summary for all the questions in the study.

Reports versus Citations

The questionnaire for this study allowed either single (mutually exclusive) or multiple responses to questions. For questions that allowed only one response, the number of total responses is always equal to the total number of unique incident reports, or individual reporters, that provided information on that topic. For questions that allowed multiple responses, findings are described as "citations" and are expressed as the total number of responses for that question. In text references to figures and charts, the number of unique reports on which an observation is based is expressed as (n=x).

Primary versus Secondary Aircraft

In this report, use of the term "primary" aircraft refers to the reporter's aircraft. Use of the term "secondary" aircraft refers to involved aircraft other than the reporter's aircraft.

FINDINGS

ASRS Database Runway Transgression Reports

In addition to the structured callback effort, ASRS extracted runway transgression data from its database that was complementary to data presented in the FAA's Runway Safety Report. Table 1 presents 11 years of ASRS data for runway transgressions for Towered and Non-Towered airports, collectively. Approximately one non-Towered or Tower-closed runway transgression event is reported to ASRS for every six events at a Towered airport. Over the 11-year period from 1990 to 2000, ASRS Database records of runway transgression events at non-Towered airports decreased slightly.

Table 1
ASRS Database Runway Transgression Reports

Year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
Towered Airports[2]	403	367	254	249	270	351	235	306	288	421	456	45	**3645**
Non-Towered Airports[3]	76	85	51	67	44	67	44	37	39	42	54	21	**627**
1. ASRS runway transgression data for 2001 are incomplete. 2. Total runway transgressions in ASRS Database with Controller involvement (Local / Ground) 3. Total runway transgressions in ASRS Database with NO Controller involvement (Local / Ground)												**Total**	**4272**

ASRS also extracted database information on the numbers of runway transgression events at each non-Towered airport listed in the database for the four-year period, 1997-2000. Appendix C presents a listing of runway transgressions for this period, with a breakdown by state and airport location.

Reporter and Mission Information

The fifty-one reports used in the callback effort spanned incident dates from September 2000 through August 2001. There were 22 reports from pilots of single-crew aircraft and 14 reports from pilots of multi-crew aircraft. The multi-crew reporter positions consisted of 11 Captains and 3 First Officers. One report was submitted by a Ramp Supervisor.

The majority of reporters represented General Aviation operators (36 reports), with 5 Air Carrier, 4 Corporate, 3 Air Taxi, 2 "Other," and 1 Commuter operator. The mission types flown were most frequently for pleasure and training (32 of 51 reports). There were no multiply-reported incidents (i.e., more than one report of a single event).

Reporter's Severity Assessment

The FAA has developed formal methods of categorizing the relative margin of safety in reported runway transgression events occurring at Towered airports.[4] This process involves detailed reconstruction of individual events and application of defined classification schemes to capture the spectrum of severity.

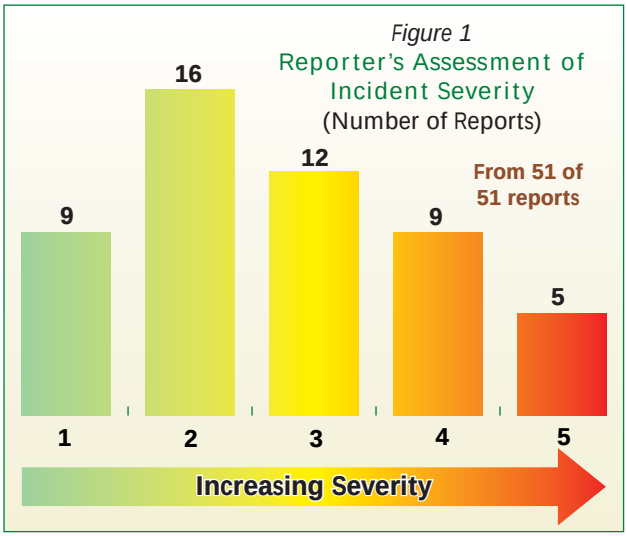
Formal safety estimation methods were beyond the scope of the ASRS study. However, participating reporters were given an opportunity to provide a subjective assessment of the severity of the event in which they were involved. Each reporter was asked the following question:

"On a scale of 1 to 5, with 1 being 'Not Hazardous' and 5 being 'Very Hazardous,' rate the severity of this event."

As shown by Figure 1, seventy-two percent (n=37) of the study reporters evaluated their incident toward the mid- to low end of the severity scale, while the remaining (n=14) assessed their events as higher severity. This general distribution of responses is identical to that for the ASRS Towered runway transgression structured callback study.

Appendix D presents a synopsis for each study report.

Figure 1
Reporter's Assessment of Incident Severity
(Number of Reports)



4 *FAA Runway Safety Report,* p. 8.

ASRS Severity Profiles

The following examples drawn from the ASRS Non-Towered Runway Transgressions data set will help to illustrate the reporters' subjective severity ranges for the events reported.

Profile 1 ..... (Reporter Severity Assessment = 1)

This incident meets the ASRS definition of a runway transgression, but the reporters' assessment is that there is little or no chance of aircraft collision.

Report Narrative

"I was getting ready to depart UIN and a Beech Baron radioed the field stating he had an electrical failure. A Cessna 310 was flying in the area practicing approaches to Runway 04 and he was asked to visually look at the Baron to confirm gear down in the air, and I was asked to taxi to a position off… Taxiway D on Runway 36 so I could watch him on a low pass…. I am on [Runway] 36 pointed towards the active Runway 13 watching the Baron. He landed safely and after I confirmed he was off the active and the 310 was gone and no other aircraft were around, I announced I would be taxiing to 13 for an intersection takeoff. I looked and observed a Piper Cherokee on final [for Runway 13]. I stopped my taxi about 100 yards short of Runway 13 and waited for the plane to land and clear. He never once used the radio to self-announce and as his plane was white and the sky was hazy, he was hard to see until he was on short final." (ACN 501398)

Profile 2 ..... (Reporter Severity Assessment = 2)

In this example, the reporter apparently misjudges traffic spacing, but believes there was little chance for a collision because there was adequate separation and both aircraft were aware of, and could see each other.

Report Narrative

"I taxied from ramp to run-up…a Twin Otter was on final for Runway 29. I proceeded with my run-up then taxied to the hold short lines. The Twin Otter called his position as Clam Cove for Runway 29. At that point the FSS person asked me if I was going to takeoff in front of the Otter or wait for him to land. I took this as an indication that enough separation existed for me to depart. I visually checked final…the Otter appeared to be at least 3 miles out. When I taxied [onto the runway] for departure the pilot of the Otter said he had to make a left turn for spacing…." (ACN 509803)

Profile 3 ..... (Reporter Severity Assessment = 3)

A severity assessment of 3 indicates that the reporter thinks there is a moderate potential for collision. In this instance, traffic landed in opposite directions on the same runway, and the other involved aircraft allegedly did not display position or anti-collision lights.

Report Narrative

"The AWOS broadcast gave winds favoring Runway 6. The CTAF was so crowded that transmissions were impossible to understand. The windsock was showing wind direction variable, but I think still favoring Runway 6. I made blind calls on downwind, base and final for Runway 6 and heard no other traffic. I landed, made the first turnoff and then saw a Tripacer that had landed on 24 turning off the far end of the runway. My aircraft was showing beacon and strobes… [but there were] no lights on the Piper." (ACN 488924)

Profile 4 ..... (Reporter Severity Assessment = 4)

A Reporter Severity Assessment of 4 indicates a relatively high potential for collision. In this example, the reporter believes a serious hazard occurred during an opposite direction operation at a Tower-closed airport with 0 feet lateral and 800 feet vertical separation.

Report Narrative

"…Tower was closed, so we transmitted on CTAF… that we were taxiing from FBO for departure on Runway 12. We heard no reply. We began our taxi and saw our company aircraft take off on Runway 9L, so we decided to taxi to Runway 9L instead. We heard our company [aircraft] radio calls as they left the airport. We did our performance checks holding short at the end of Runway 9L. We then called out that we were *'taking off Runway 9L, any traffic please advise.'* There was no reply…. As we took position we cleared final and departure ends, both seemed clear. We finished our takeoff check and prepared to depart, when the pilot flying saw the anti collision lights of an aircraft approaching us from the opposite end. We then turned to get off the runway as we saw what looked like a Challenger jet take off Runway 27R over us…. We never heard a single radio call from the jet that departed Runway 27R." (ACN 482051)

Profile 5 ..... (Reporter Severity Assessment = 5)

In this incident, the reporter, a Ramp Supervisor, believes a near accident occurred when a commuter aircraft missed a snowplow by an estimated 5 feet. Note in this example of problematic communications that the city-operated snowplows are apparently not able to communicate directly with aircraft via UNICOM.

Report Narrative

"The Airport uses a City and UNICOM radio when snowplows are on the airport grounds. Aircraft radio [using UNICOM] and [company] personnel call the city and advise them of the inbound aircraft. I am the Ramp Supervisor…and was needed at the hanger to pull an aircraft out. When I was done with the job the driver of the snowplow came over and informed me of a near miss with an aircraft. I went in the FBO, where my boss

was supposed to be monitoring the radio in my absence, and she was on the phone oblivious to the situation. I…talked to the pilots of the EMB-120 and they informed me that the snowplow exited the runway and then backed up onto the active while they were landing. The pilot initiated a go-around and missed the plow by an estimated 5 feet…. City plows are not equipped with an aviation radio and when my boss was asked about this she said *'it doesn't do any good because they don't understand aviation jargon.'* This isn't the first time this has happened, however this is the closest we have come to an accident and it is obvious that the current standards of advising aircraft and snowplows does not work." (ACN 496963)

Alerting Source and Evasive Action

Reporters were asked what sources alerted them to the conflict. In 35 percent of incidents, the reporter was not alerted to the conflict by any source. Information received by radio (UNICOM, CTAF, etc.) provided an alert in 26 percent of the incidents. Communication from other pilots was the alerting source in 14 percent of events, and pilots' visual see-and-avoid observations were the alerting source in another 14 percent of incidents.

The following report excerpt shows how a third party intervention on UNICOM helped resolve a traffic conflict:

"While holding short of the runway (single 4000 feet) on the taxiway, my student and I heard an indistinct transmission on the aircraft radio neither of us made out what it was. I instructed the student to visually clear the approach path, which he did. We radioed that we were back taxing on Runway 23 then taxied on to the active. Just as we were on the runway, UNICOM (in the FBO) advised there was an aircraft on final. I looked and saw the T-34 on a close-in base to final. I immediately took control of our aircraft and taxied onto the grass…." (ACN 486069)

As the following report illustrates, pilots comunicating on different frequencies may contribute to traffic conflicts:

"… As I was taxiing the pilot of the other aircraft approached me and became belligerent stating that I crossed in front of him. I informed him that I was on the CTAF and was speaking with other traffic and that we never heard or saw him. He argued that the proper frequency is 122.95, which is the UNICOM for this field. I explained that Orlando Approach told us to contact traffic on the CTAF and that we were speaking with the other traffic…." (ACN 483236)

Pilots of primary aircraft took evasive actions such as aborting takeoff, altering their flight path, or initiating a go-around in 61 percent of events. In 47 percent of responses, the secondary involved aircraft took evasive action. Reporters asserted that they had performed a "clearing maneuver" prior to the transgression incident in 51 percent of events.

Airport Demographics

Airports

Of the 51 runway transgression reports that served as a basis for the Non-Towered Runway Transgressions study, a single reported event occurred at 43 airports. There were three airports with two reported incidents each, and two additional airports were de-identified to protect reporters. In total, there were 48 unique airport locations represented in the data set. Sixteen airports had Control Towers, but the Tower was closed at the time of the incident. Approximately 26 percent of incidents occurred at multi-use airports (i.e., those airports supporting a wide variety of operations such as glider flying and skydiving).

Activity Level

Reporters were asked to evaluate the level of airport traffic activity at the time of the occurrence. Figure 2 shows that 82 percent of incidents (n=42) occurred during "Low" to "Moderate" activity periods. Sixteen percent of incidents (n=8) occurred when the airport activity level was judged to be "High." In one incident the traffic volume was "Unknown."

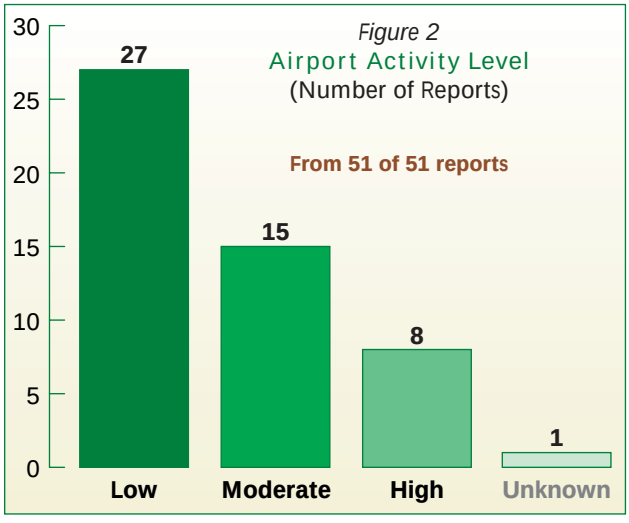


Figure 2
Airport Activity Level
(Number of Reports)
From 51 of 51 reports

Runway Configuration

Sixty-four percent of the transgression events (n=32) occurred at airports with intersecting, or intersecting and parallel runway configurations. Thirty-four percent of events (n=17) occurred at airports with single runways. Figure 3 depicts the runway configurations for the non-Towered transgression data set.

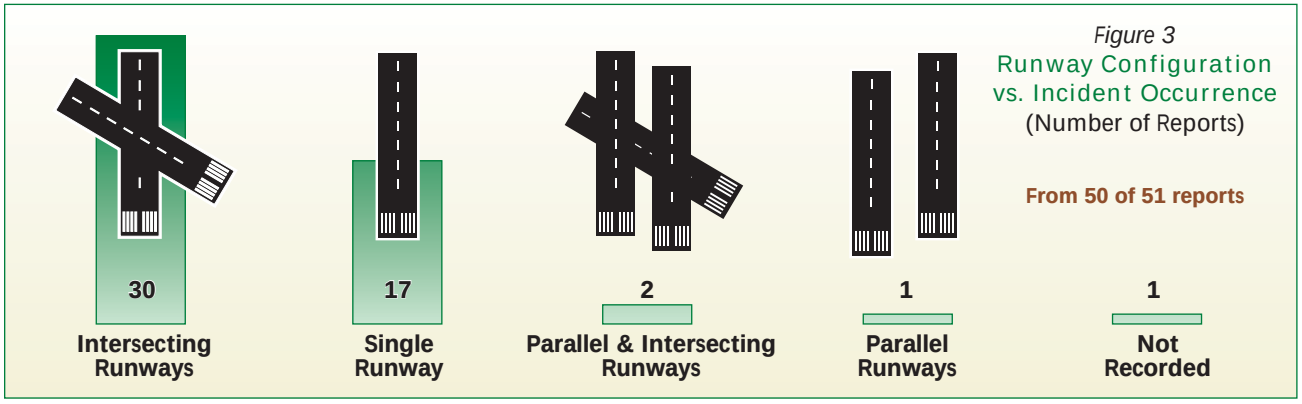


Figure 3
Runway Configuration vs. Incident Occurrence
(Number of Reports)

From 50 of 51 reports

Runway Selection Criteria

Reporters were asked whether factors such as wind direction, runway slope, approach/departure obstacles, or runway(s) in use by other aircraft influenced their choice of a departure or landing runway. They were allowed to identify more than one of these factors, if applicable. Reporters cited wind direction as a selection criteria in 63 percent of citations (n=38), while the runway direction in use by other traffic was cited 32 percent of the time (n=19). Overall, wind direction was twice as likely to influence pilots' choice of a runway for takeoff or landing as traffic flow.

> "The AWOS broadcast gave winds favoring Runway 6. The CTAF was so crowded that transmissions were impossible to understand. The windsock was showing wind direction variable, but I think still favoring Runway 6. I made blind calls on downwind, base and final for Runway 6 and heard no other traffic. I landed, made the first turnoff and then saw a Tripacer that had landed on 24 turning off the far end of the runway…." ACN 488924

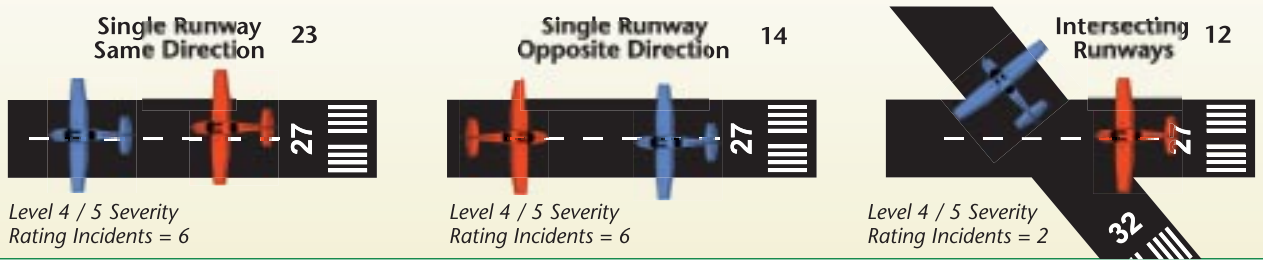
Traffic Direction for Runway(s) in Use

The ASRS structured callback questionnaire asked reporters to describe traffic direction in relation to runway(s) in use at the time of the event. "Runway in use" is a term that generally describes the runway (or multiple runways) favored for takeoffs and landings because of wind direction, although prevailing traffic flow may also dictate runway selection. A non-Towered airport with parallel or intersecting runway configurations will often have just one runway "in use" for takeoffs and landings. In the case of a non-Towered airport with only one runway, takeoffs and landings may occur from opposite ends of the same runway if wind and airport traffic conditions permit.

In the ASRS study data, 45 percent (n=23) of the non-Towered transgression events occurred with traffic operating from a single runway and in the same direction (Figure 4). In 28 percent of events (n=14), the involved aircraft were operating from a single runway but in opposite directions. In 24 percent of events (n=12), aircraft were operating from inter-

Figure 4
Runway Use at Time of Incident
(Number of Reports)

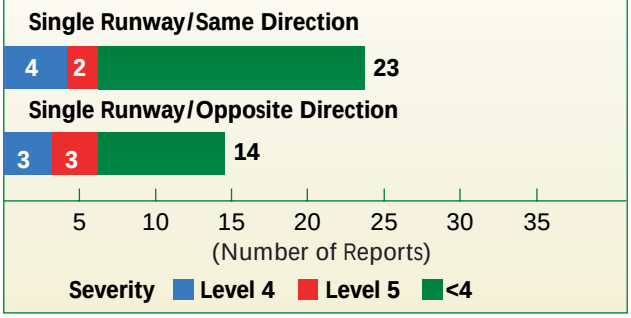
From 50 of 51 reports



secting runways at the time of the event. Overall, almost three-fourths of the non-Towered study incidents involved traffic operations at airports where a single runway was in use.

Incidents assessed by the reporter with a Severity Rating of a level 4 or 5 were compared to the runway in use at the time of the incident. Each traffic configuration, "Single Runway, Same Direction" and "Single Runway, Opposite Direction," comprised of a total of six level 4 or 5 incidents, even though there were 40% fewer "Single Runway, Opposite Direction" reports in the data set (Figure 5).

Figure 5
Traffic Direction for Runway in Use with High Severity Ratings



Geographical and Topographical Factors

Geographical or topographical conditions that obstructed pilots' vision of runway final approach paths or other airport traffic — trees, terrain, runway "humps," or tall buildings — were identified by reporters as contributors to 45 percent (n=23) of the non-Towered runway transgressions. This is in strong contrast to ASRS's finding on the influence of such factors in Towered airport transgressions, where only four percent (n=3) of the Towered study runway transgressions reflected these factors. No geographical or topographical factors were noted in the remainder of the non-Towered incidents.

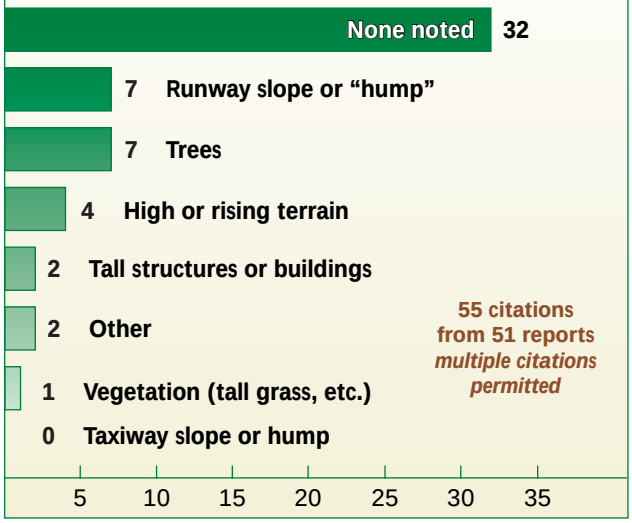
Figure 6 shows that runway gradient, trees, and terrain were the most frequently cited geographical and topographical factors contributing to the runway transgression event.

In the following example, a "runway crown (or hump)" was a major factor affecting visual sighting of runway traffic, and possibly impeding VHF (line of sight) radio communications.

"… I announced on CTAF that we would be starting our taxi [to Runway 2]. An air carrier (Y) flight stated the same. A Cherokee (Z) stated he was taxiing to Runway 20. The COU FSS called the Cherokee on CTAF to advise him that two commuter aircraft were taxiing to Runway 2, and the winds favored Runway 2. The Cherokee did not reply.... during our taxi the Cherokee made one transmission that was garbled and unreadable.... Upon rolling onto the approach end of Runway 2, prior to applying any takeoff power I asked *'Cherokee at COU, this is Air Carrier (X), we need to know where you are?'* We got no response from him so we applied the brakes and stopped on the runway. After approximately 5 seconds we observed lights and a beacon coming at us. The captain immediately maneuvered the aircraft to the... left. By this time the Cherokee was climbing and passed well overhead. We had a problem with our nose wheel steering and we unable to clear the runway. Had the Cherokee not climbed above us we would not have been able to exit the runway or get out of the way.... A pilot at the end of Runway 2 cannot observe the end of Runway 20 due to a crown in the airfield." (ACN 485874)

In another event, the pilot of a Cessna Citation departing Runway 14 experienced a traffic conflict with a Beechcraft Baron departing on intersecting Runway 22, and notes that trees *"…obstructed visual from departure end Runway 14 to departure end Runway 22...."* (ACN 495574)

Figure 6
Geographical and Topographical Factors
(Number of Citations)



Airport Communications Capability

When reporters were questioned about airport communications capability, they indicated that all airports represented in this data set had some form of radio communications. As Table 2 shows, reporters identified 50 of 51 airports (98 percent) as possessing CTAF and/or UNICOM communications capability.[5] A large majority of reporters (94 percent) also reported feeling comfortable with non-Towered airport communications procedures.

Table 2
Airport Communications Capability

Communications Capability	Citations
CTAF / UNICOM	21
UNICOM only	13
CTAF Only	12
CTAF / UNICOM / FSS	3
CTAF / Multicom	1
FSS	1
TOTAL	51
From 51 of 51 reports	

Pilot Background and Use of Resources

The ASRS questionnaire also probed reporters' backgrounds and use of available resources. Ninety percent of reporters (n=46) had not previously experienced a runway transgression at the airport where the incident occurred.

Pilot Experience

The reporters averaged several thousand hours of flight experience, and most were considered to be experienced pilots. Their total flight time ranged from 75 to 22,549 hours, with an average of 3,350 flight hours and a median of 1,740 flight hours. They also appeared to be current in their flight activities, averaging 83 flight hours within the 90 days preceding the incident, with a median of 40 flight hours in this period.

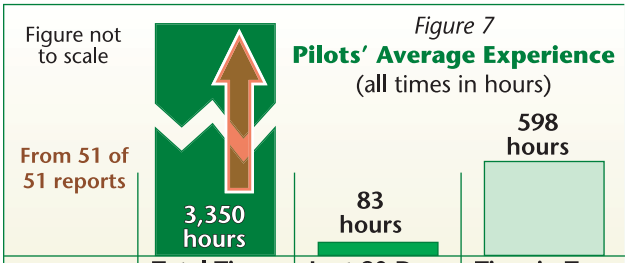
Reporters were also experienced in the aircraft type involved in the incident. Total "time in type" averaged 598 hours, with a median of 269 hours. For multi-crew operators, the duty time in hours prior to the incident averaged 1.5 hours (median 0.9 hours), and ranged from 0 to 8 hours.

In the following example, a commercial cargo aircraft and a large corporate jet experienced a conflict during opposite-direction runway operations. The Captain of the cargo aircraft had 3,000 total hours, 2,600 hours in aircraft type, and 300 hours in the previous 90 days; it is reasonable to assume that the flight crew of the corporate jet was similarly well experienced.

> "…Opa Locka's tower was closed, so we transmitted on the CTAF frequency 120.7 that we were taxiing from FBO for departure on Runway 12. We heard no reply. We began our taxi and saw our company aircraft take off on Runway 9L, so we decided to taxi to Runway 9L instead… we then called out that we 'were taking off Runway 9L any traffic… please advise.' There was no reply… As we took position we cleared final and departure ends, both seemed clear. We finished our takeoff check and prepared to depart, when the pilot flying saw the anticollision lights of an aircraft approaching us from the opposite end. We then turned to get off the runway as we saw what looked like a Challenger jet take off Runway 27R over us…." (ACN 482051)

Figure 7 depicts reporters average hours, time within the 90 days preceding the incident, and total time in type.

Figure 7
Pilots' Average Experience
(all times in hours)



	Total Time	Last 90 Days	Time in Type
Average	3,350	83	598
Median	1,740	40	269
Minimum	75	6	4
Maximum	22,549	350	4,000

Previous Visits to Airport

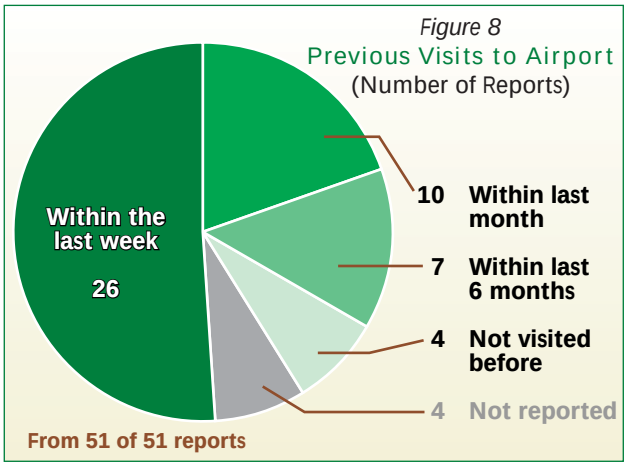
Seventy-one percent (n=36) of the reporters stated they had flown into or out of the airport more than five times prior to the date of event occurrence. This finding is very similar to that of the ASRS Towered runway transgression study, in which 88 percent of pilot reporters (n=72) had visited the airport of incident occurrence more than five times. Fourteen percent (n=7) of the non-Towered study reporters had not previously visited the airport where the incident occurred.

5 As noted in section 4-1-9 of the *Aeronautical Information Manual*, the CTAF is a frequency designated for the purpose of carrying out airport advisory practices while operating to or from an airport without an operating Control Tower. The CTAF may be a UNICOM, MULTICOM, FSS, or Tower frequency and is identified in appropriate aeronautical publications. UNICOM is a non-government air/ground radio communication station that provides airport information at public use airports where there is no Tower or Flight Service Station (FSS).

A report from the ASRS Database provides an example of the problems resulting from a lack of familiarity with the airport.

> "…I was inbound on the localizer [at TEX] when I broke out approximately 2500 feet AGL. As I was attempting to land on Runway 9, another aircraft was taking off of Runway 27. I made a left downwind to land on Runway 27. On my left base for Runway 27, another airplane had landed on Runway 27, but was back taxiing. I aborted the landing and re-entered for a left downwind and had an uneventful landing. I have since learned all landings are to be made on Runway 9 and a right traffic pattern should be used if needed on Runway 27. **What really caused the incident was my unfamiliarity with the airport**…." (ACN 518664)

Figure 8 shows that of the non-Towered study pilots (n=43) who had previous experience flying into the airport, 61 percent (n=26) had arrived at or departed from the airport during the week prior to the event, and another 23 percent (n=10) had operated there within the previous month.



Use of Charts and Training

In 21 percent (n=11) of the non-Towered transgression events, reporters did not refer to a navigation chart or aviation publication prior to the incident. Almost three-fourths of reporters (n=37) did check for NOTAMS before flight. Forty-three of these pilots obtained NOTAMS from Flight Service Stations (FSS). Other NOTAM sources cited were DUATs, company Dispatch, and AWOS.

In another example from the ASRS Database, the reporter failed to either carry or utilize the airport surface chart.

> "On a night training flight with a private pilot working on his commercial certificate, I wanted to see how my student would conduct himself entering the pattern and landing at an unfamiliar airport… the airport's Tower was closed, so my student made all the appropriate calls on the CTAF…. We had a normal landing on the proper Runway 19R and taxied clear…. Unfortunately, not having planned on taxiing at Concord, we did not have an airport diagram with us. Upon taxiing back, we… eventually found ourselves on the middle of another big runway…. We were a little disoriented by the signs and runway markings when my student said, 'this must be it,' meaning our runway… I said, 'let's go.' On the take-off roll, I noticed that those white edge lights were quickly gone and once we were airborne I knew we had done something wrong. I wasn't until back on the ground at our home airport where I looked at an airport diagram and figured out that we had taken off of closed Runway 14L…. (ACN 306694)

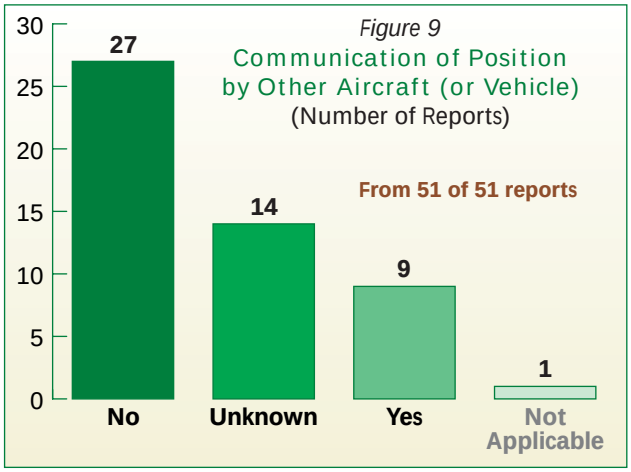
Training activity was cited in 25 percent (n=13) of the non-Towered events. Of the thirteen pilots who reported training activity, four were involved in private pilot instruction, two in instrument training, and seven in other types of proficiency practice.

Aircraft Communications

Ninety-six percent of the study pilots (n=49) were flying radio-equipped aircraft, and ninety-two percent (n=47) were using the radio(s) at the time of the incident. There were few claims of aircraft radio problems, frequency congestion, frequency overlap, or other communications problems. As illustrated in the following narrative, pilots admitted to using the wrong frequency in 12 percent (n=6) of occurrences.

> "… My student announced our departure on UNICOM and started our takeoff roll. Shortly after commencing our roll, I noticed several lights at [our] 2 o'clock position with no relative motion and yelled at my student to stop. He aborted the takeoff and stopped about 500 feet short of Runway 26L (we were on Runway 35) and we watched the C-130 Hercules roll by and stop in another 1000 feet. We then took off and completed the flight without incident, thinking that the C-130 was on the wrong frequency. The next day, I checked the Airport Directory and discovered that the after hours CTAF was not UNICOM…." (ACN 475300)

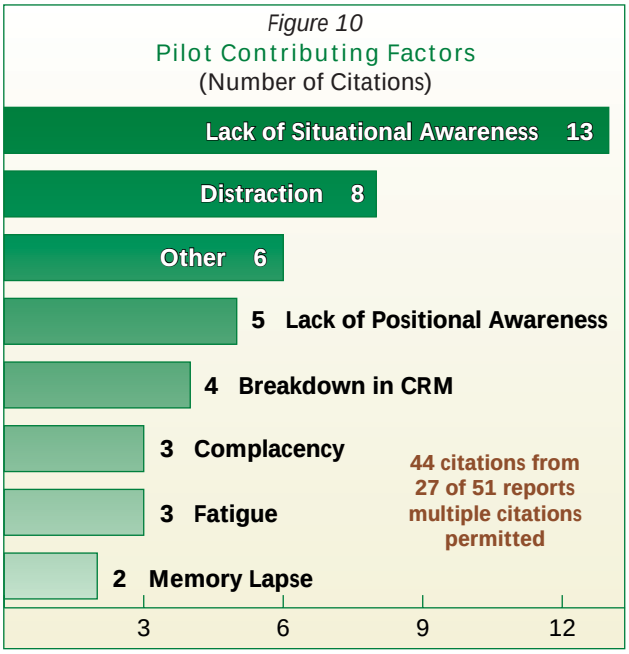
In 18 percent (n=9) of the study incidents, reporters acknowledged they were using or monitoring more than one frequency at the time of the incident. As seen in Figure 9, fifty-three percent (n=27) of the study pilots also insisted that the other aircraft (or vehicle) did not communicate its position clearly. The following report demonstrates the risk associated with losing awareness of another aircraft's position.



"… I announced on CTAF that we would be starting our taxi [to Runway 2 at COU]. An air carrier flight stated the same. A Cherokee stated he was taxiing to Runway 20. The COU FSS called the Cherokee on CTAF to advise him that two commuter aircraft were taxiing to Runway 2, and the winds favored Runway 2. The Cherokee did not reply… during our taxi the Cherokee made one transmission that was garbled and unreadable…. Upon rolling onto the approach end of Runway 2, prior to applying any takeoff power I asked 'Cherokee at COU this is Air Carrier (X), we need to know where you are?' We got no response from him so we applied the brakes and stopped on the runway. After approximately 5 seconds we observed lights and a beacon coming at us. The captain immediately maneuvered the aircraft to the west (left). By this time the Cherokee was climbing and passed well overhead…. (ACN 485874)

Pilot Contributing Factors

Reporters were also questioned about the possible influence on their incident of factors related to attention, aircraft equipment, operational/technical factors, and time pressure. Reporters were allowed to cite more than one factor if it was applicable. Figure 10 shows that lack of situational awareness[6] and distraction were the most frequently cited contributing factors. The "Other" category of contributing factors included "rushing," "visual signature of other aircraft," and an "airsick passenger." Aircraft equipment problems, operational/technical factors, and schedule pressure did not appear to be major contributors.



In one example of problematic situational awareness, the flight crew of a Gulfstream IV taxiied across a runway occupied by a Cessna. The crew of the corporate jet, noting *"high work load immediately after starting the taxi… multiple runways in use,"* and *"13 time zones in 3 days,"* asks the question, *"was our situational awareness at 100%?"* The reporter answers his own question by stating *"be aware of effects that crossing multiple time zones can have on one's body clock, contributing to a lessened situational awareness."* (ACN 493458)

6 "Situational awareness is defined as a continuous extraction of environmental information, integration of this information with previous knowledge to form a coherent mental picture, and the use of that picture in directing further perception and anticipating of future events. Simply put, situational awareness means knowing what is going on around you." (FAA Facility Operation and Administration handbook, 7210.3, Part 2-6-1.)

In another example, an instructor pilot engaged in twin-engine flight training admits that instructional task saturation contributed to distraction:

"… I became extremely occupied with my student's progress throughout the maneuver by ensuring that he was consistently flying the proper airspeed, setting the proper crab angle and managing his altitude effectively, especially for the base to final turn to come. On short final, as I focused my attention on coaching my student with crosswind control inputs and with the decision to use flaps, I noticed the Warrior slowing to turn on a taxiway that is more than halfway down the runway. I made a prediction that by the time we flared, the Warrior should be safely clear. However, momentarily distracted with my student's final flaring inputs, I failed to notice that as we were touching down the Warrior had not cleared the runway…. distraction within the cockpit was a big factor." (ACN 510231)

Environmental and Other Factors

ASRS also captured information on factors that appeared to have a neutral or negligible influence on the event consequences in this study. These factors are discussed in this section of the report.

Day and Time

More events were reported for Saturdays (24 percent, n=12) than other days of the week. Over half of events 51 percent, (n=26) occurred between the hours of noon and 6:00 P.M., while another 37 percent (n=19) took place between 6:00 A.M. and Noon. A greater percentage of General Aviation flights into and out of non-Towered airports tend to occur on weekends and during daylight hours.

Aircraft Involved

A wide variety of aircraft were involved in the study's runway transgression events, ranging from sailplanes and helicopters to transport category jets. The majority of involved aircraft were light single-engine fixed-wing aircraft. There were two encounters between an aircraft and a ground vehicle. Wing configuration (i.e., high wing vs. low wing) was not identified as an event contributor.

Weather

Weather conditions did not play a significant role in runway transgressions at non-Towered airports. The majority of the runway transgressions events occurred in daylight and Visual Meteorological Conditions (VMC).

Runway and Taxiway Conditions

All operations from the study data occurred on runways that were paved, and in 90 percent of the incidents (n=46), the airport had one or more taxiways. Of the 46 airports with taxiways, only one taxiway was reportedly not marked with a hold line.

REPORTERS' COMMENTS

Reporters offered many training, procedural, and technology suggestions for the reduction of runway transgressions at Towered airports. These comments are summarized in Appendix F.

SUMMARY

ASRS Database Baseline Data

- Approximately one non-Towered runway transgression event is reported to ASRS for every six events at a Towered airport. ASRS received 627 total reports describing runway transgression events at non-Towered and Tower-closed airports between 1990-2001. Over this 11-year period, ASRS Database records of runway transgression events at non-Towered airports decreased slightly, in spite of an increase in total reporting to ASRS over this same period.

Structured Callback StudyData

Incident Severity

- Each study respondent was asked to assess the severity of the reported transgression event on a scale of 1 to 5, with 1 being "Not Hazardous" and 5 being "Very Hazardous." Seventy-two percent of the respondents evaluated their incidents in the 1-3 severity range ("low" to "moderate" severity), while the remaining respondents rated their events in the 4-5 severity range (higher severity). This distribution of responses is identical to that for the ASRS Towered runway transgression structured callback study.

Alerting Source

- Pilots were asked what sources alerted them to the runway transgression. Information received by radio (UNICOM, CTAF, etc.) provided an alert in 26 percent of the incidents. Communication from other pilots and pilots' visual observations were the alerting source in an additional 28 percent of incidents. In 35 percent of incidents, the pilot was not alerted to the conflict by any source.

Airport Demographics

- There were 48 unique airport locations represented in the structured callback study data set. Sixteen airports had Control Towers, but the Tower was closed at the time of the incident. Approximately one quarter of the study incidents occurred at multi-use airports – those supporting a wide variety of operations such as glider flying and skydiving. More than three-fourths of the study incidents occurred during periods of airport activity described as "low" to "moderate" by respondents.

Airport Physical Issues

- Almost three-fourths of the non-Towered study incidents involved traffic operations at airports where a single runway was in use, generally because of wind direction or runway use by other traffic. Wind direction influenced pilots' choice of a runway for takeoff or landing twice as much as traffic flow.
- This study found that geographical or topographical obstruction to pilots' line of sight was a factor in approximately 45 percent of the runway transgression events. Runway slope, trees, and rising terrain were the most frequently cited obstructions. While the adverse effect of visual obstructions such as trees and vegetation can be minimized through regular airport maintenance, others such as runway gradient and buildings are more difficult to correct.

Airport Communications

- A large majority of the reporters interviewed said they felt comfortable with non-Towered airport communications procedures and used aircraft radios to self-announce their position and intentions. However, they claimed that other pilots did not communicate their positions clearly (in 53 percent of the incidents), or seemed confused about the proper frequency to use (in 12 percent of incidents).

  Some pilots may not fully understand the differences among all the published communications frequencies for a given airport – UNICOM, Multicom, FSS, Tower, CTAF, etc. – and when it is appropriate to use each frequency. A practical suggestion for alleviating frequency confusion offered by study respondents is the installation of signs at runway ends specifying the CTAF frequency for the airport.

  It is also likely that continuing pilot education is needed in standard communications practices at non-Towered and Tower-closed airports. These educational efforts might include recurrent training (Biennial Flight Reviews); FAA seminars and videos; pilot publications; and internet accessible articles and tutorials.

Pilot Contributing Factors

- Lack of situational awareness was the factor most frequently identified as contributing to the non-Towered runway transgression events. The majority of pilots interviewed for this study could be considered experienced and familiar with the airport. They also enjoyed good weather conditions and low-to-moderate traffic volume. Under these favorable circumstances, it is possible that lowered levels of situational awareness can result from a reduced expectancy level and the lack of attentional stimuli.

  Some of these factors may be best addressed through recurrent training and the dissemination of educational information through publications, videos, and other methods. Several reporters advocated that the FAA focus on runway transgression prevention in the General Aviation community through its "Wings" program and reactivation of the "See and Be Seen" program.

New Technology Solutions for Non-Towered Airports

- A few reporters noted the difficulty of determining the active runway at some non-Towered fields, especially those with multiple runway configurations, and suggested that some method of auto-announcing the active runway (such as a simplified ATIS) would be helpful. Others suggested that a means of auto-detecting other aircraft on a runway with a hump or slope would be helpful.

OPERATIONAL OBSERVATIONS

A thorough review of contributing factors identified in the 51-report Non-Towered Runway Transgressions data set provided the following operational observations:

- A significant number [14] of pilots of radio-equipped aircraft in this data set did not utilize their radios.
- Some pilots experience confusion over whether to use CTAF or UNICOM for traffic advisory communications, or may attempt to use frequencies other than CTAF or UNICOM.
- High traffic volume and radio congestion at non-Towered airports were associated with breakdowns in radio discipline and contribute to confusion and loss of situational awareness.
- FBO and other ground personnel, operating UNICOMs or other advisory frequencies, occasionally attempt to act as "pseudo" air traffic controllers.
- This study confirmed that some pilots continue to ignore AIM/FAR procedures for operations at uncontrolled airports. Non-standard traffic pattern entry and pattern procedures such as straight-in approaches, or "wrong-side" traffic patterns, often led to runway transgression conflicts.
- Non-Towered airport traffic may utilize a runway not favored by wind direction — this can generate a dilemma for other departing or arriving pilots with respect to runway selection. Similarly, pilots can experience confusion with respect to runway selection when the wind is calm.
- Low traffic volume, familiarity with an airport, and favorable flight conditions were factors that contributed to pilot complacency.
- A variety of small general aviation aircraft have small visual signatures, leading to difficulty in detection by other pilots.
- Runway humps and other obstructions can inhibit radio transmissions between aircraft on the opposite ends of a runway, as well as impede visual acquisition of traffic. Similarly, visual obstructions (such as trees) between runway ends can significantly increase risks in intersecting runway operations.
- Pilots of larger aircraft operating under Instrument Flight Rules (IFR) frequently conduct "straight-in" approach and landing operations when in Visual Meteorological Conditions (VMC), often to a runway not in use by other traffic. This can lead to runway conflicts with pilots of other aircraft who anticipate normal traffic pattern entry and procedures by the larger traffic.
- Pilots of IFR departures can experience breakdown's in situational awareness and traffic monitoring tasks when feeling rushed to meet "clearance void" times.
- Breakdown's in CRM and traffic monitoring duties have occurred during flight training operations.
- Preoccupation with GPS programming and other "heads-down" tasks during outbound have resulted in failure to adequately monitor aircraft position and/or other traffic at non-Towered airports.
- Vehicle drivers may fail to observe appropriate procedures when operating their vehicles in aircraft movement areas at non-Towered airports.
- Special events, such as fly-in's, club events, and competitions are often associated with the conduct of non-standard procedures at non-Towered airports.

REFERENCES

Federal Aviation Administration. Office of Aviation Safety. 2001. Runway Transgression Severity Trends at Towered Airports in the United States, 1997-2000.

Federal Aviation Administration. Office of System Safety. 2000. "Airport Surface Movement Area Data Analysis (Version 2)." Slide presentation.

Appendix A

ASRS Non-Tower, and Tower-Closed Airports Structured Callback Study Form