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Pushback Accidents Reviewed To Identify Causes and Prevention

A survey of airline safety professionals, ground crews and aircrews from 16 countries suggests that engineering solutions are needed to prevent aircraft pushback accidents, and a review of accidents in the period 1964 through 1992 indicates that pushback accidents have been increasing.

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Forty-six aircraft pushback accidents that resulted in death or injury to pushback crew members were reported worldwide in the period 1964 through 1992. Twenty-one of these accidents occurred in the last four years of the period.

In most of the accidents, the pushback crew members were run over by the aircraft or the pushback tug. In a small number of cases, tug drivers were crushed during collisions between the aircraft and the tugs. Evidence indicated that the pushback crew members who sustained injuries were required to remain in or near the hazard zones associated with the aircraft or tugs during all or part of the pushback operations. In addition, those injured aircraft dispatchers among pushback crew members were in communication with the aircrews in the aircraft cockpits and were connected to the aircraft via headsets and cables when the accidents occurred.

As Figure 1 (page 2) shows, there has been an increased occurrence rate in recent years: 25 accidents occurred from 1964 to 1988 (1.00 per year) and 21 from 1989 to 1992 (5.25 per year).

The reasons were not apparent for the increase in pushback accidents in recent years. Nevertheless, one factor may be the increased attention to, and recording of, these events in recent years. The increase in pushback accidents may also be the result of an increase in the number of pushbacks conducted.

Airlines commonly use as many as four persons in their pushback crews. A crew can comprise a dispatcher, a driver and one or two observers or wingwalkers.

Wingwalkers walk along with the wingtip to ensure that it clears obstructions, and generally have no other duties. The

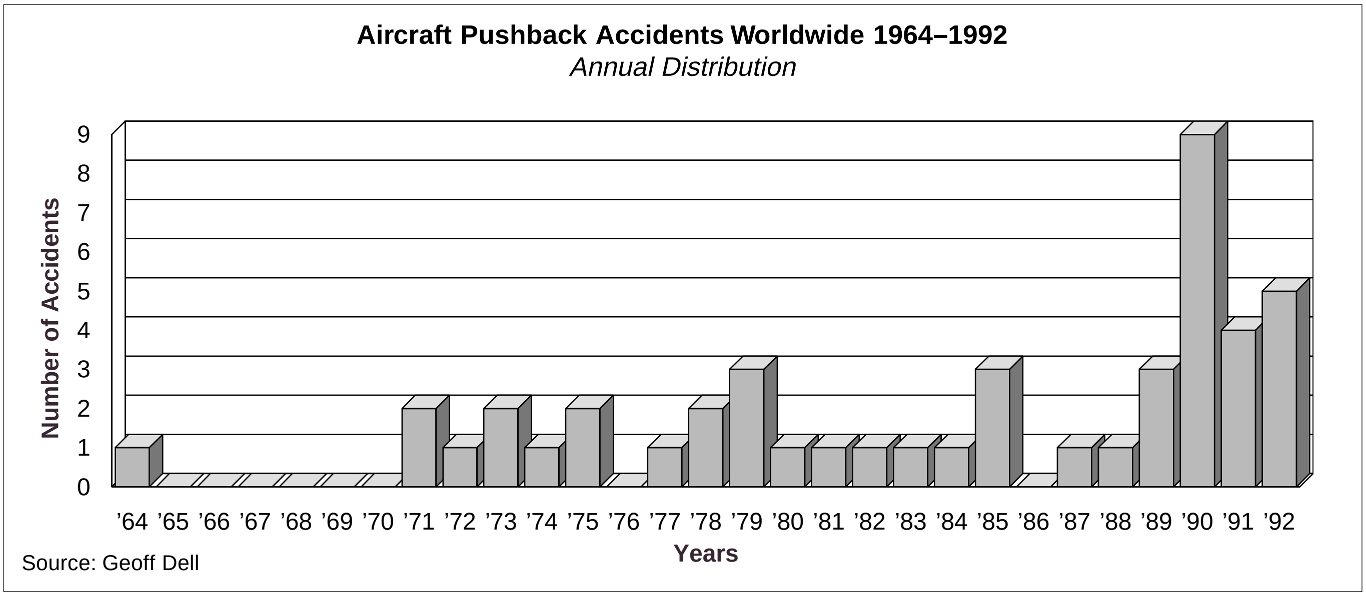


Figure 1

dispatcher on the headset is usually in command of the pushback operation and is in communication with the flight deck. The dispatcher is responsible for ensuring that the pushback operation is carried out safely and that the area behind the aircraft is unobstructed. At many airlines, the dispatcher also has the responsibility to monitor engines for start abnormalities, such as fires. When pushback is completed, it is the dispatcher's responsibility to ensure that all equipment and personnel are clear of the aircraft and that the nose-steering bypass pin is removed. The dispatcher's final duty is to give a "thumbs up" to the flight crew that the aircraft is clear to taxi.

Many airlines have two people walk beside the aircraft during pushback, a dispatcher with a headset and an observer. The observer often walks along the fuselage opposite to the dispatcher. For the purpose of this study, an observer is defined as any person walking beside the aircraft nose without a headset.

To prevent accidents and injuries during pushback, many airlines have relied on personnel to comply with procedures to keep them outside hazard zones associated with the aircraft undercarriage and the pushback tug. At many airlines, such procedures are well documented and provide explicit instructions for the pushback operation.

Procedures designed to prevent accidents require compliance to be effective. Unfortunately, this reliance on human behavior leaves accident prevention exposed to such human frailties as distraction, concentration lapse, tiredness, poor understanding and frustration. (The U.S. National Transportation Safety Board [NTSB] has said that "pushback procedures that require ground personnel to be close to the nose gear and directly connected to the communication panel in the nose-gear well are unnecessary and unsafe.")

There is a need for a shift in emphasis away from procedural compliance in pushback accident prevention to development of engineering solutions that provide safer pushback operations.

To understand pushback accident causation, and therefore, prevention, the 46 pushback accident reports were analyzed. In addition, 24 airline safety professionals (those responsible for development and monitoring of airline safety policy or airline ground safety managers), 15 dispatchers, 10 pushback drivers, five senior captains and two manufacturers' representatives were interviewed. Interviews were conducted in 11 cities in eight countries from January 1993 to October 1993. Those interviewed came from 25 cities in 16 countries. The interview information was used to determine a range of measures that, when applied to pushback operations, would reduce the risk of accidents and injuries.

Hogwood recorded the occurrence of 33 pushback accidents since 1968.[1] Although no causation information was included, the data were used as a basis for further research. Preliminary analysis of the Hogwood data indicated that aircraft pushback accidents were increasing.

Only four other papers[2,3,4,5] that addressed pushback injuries and injury prevention were found during extensive searches of online data bases and scientific and trade journals. There was a scarcity of reference to sources of data and information throughout the literature. All sources focused on modifying the behavior of the individual as a central prevention strategy.

For example, Barnett suggested that "a basic tenet is that ground personnel be constantly aware of their position relative to that of the airplane and that when airplane movement is imminent or in progress, the personnel position themselves accordingly."[3]

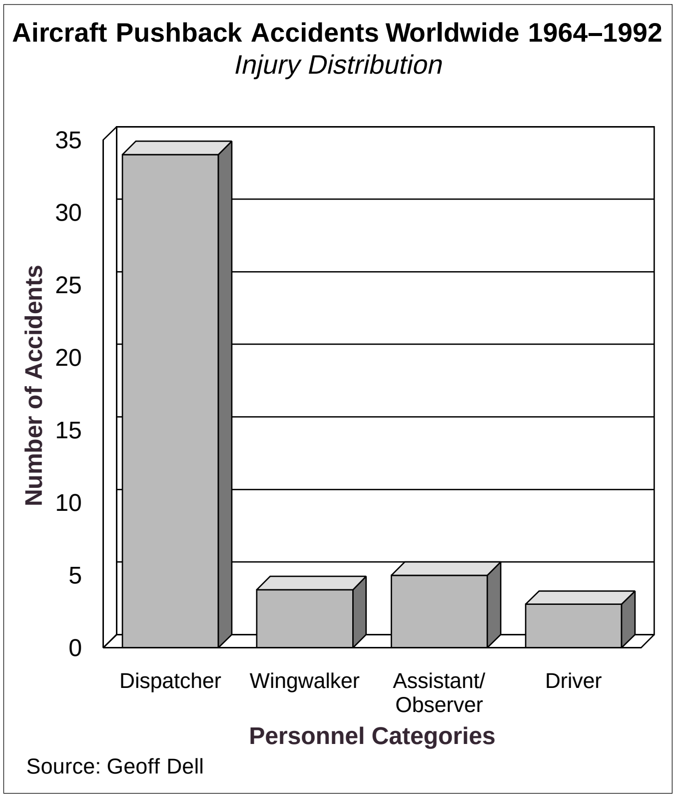


Figure 2

Anderson agreed, stating that "staying alert and clear of the path of the airplane's wheels is essential to preventing injuries," and "carelessness and inattention have contributed to 78 percent of the accidents."[2] Van Paasschen argued that "accident prevention still depends on the individual exposed to the hazard."[5] Jackson further emphasized the responsibility of the individual and suggested that "staying alert and clear of the path of the airplane's wheels is essential to prevent injuries," and "there needs to be an increase in awareness about carelessness and inattention."[4]

Hazard awareness and training were seen as the key solutions to preventing pushback accidents. However, Anderson also suggested that there was a need to "change the pushback procedure to prohibit personnel in the hazard area," adding that "one method for accomplishing this is to have the tug driver conduct communications with the airplane flight crew."[2]

Injury-to-dispatcher accidents constituted 74 percent of all accidents in this study (Figure 2). The additional events reviewed in this study, which were not included in Hogwood, were those in which crew members other than the dispatcher were injured (Figure 3) and one in which there were no injuries. These events are also increasing, with half of them occurring in the last three years of the study period.

Injuries sustained in the pushback accidents were predominantly severe. Thirty-one (67 percent) of the 46 accidents resulted in limb amputations or fatalities. This overall trend was consistent within each personnel category: 71 percent of dispatchers, 100 percent of wingwalkers, 67 percent of assistant/observers and 100 percent of drivers suffered limb amputations or fatal injuries. In all, the study found that there were a total of 21 fatalities in the 46 accidents, including 14 dispatchers, one wingwalker, three observers and three drivers. There were 13 limb amputations where the accident victims survived.

A high percentage of the accidents involved aircraft nosewheels (Figure 4, page 4). Thirty of the 46 accidents (65 percent) were the result of nosewheel impact or runover. In addition, four accidents involved aircraft main wheels. This brought the total aircraft involvement in injury causation to 74 percent of the accidents. Category A aircraft (aircraft with five feet [182 centimeters] or more clearance between fuselage and ground) were involved in 74 percent of all accidents (Figure 5, page 4) and 91 percent of those that involved the aircraft nosewheel or main wheels as the cause of injury (Figure 6, page 5).

Figure 4 shows that the pushback tug or towbar was involved in 11 (24 percent) of the 46 accidents. While this percentage is small by comparison with aircraft involvement, Figure 7 (page 5) shows that Category B aircraft (aircraft with less than five feet [182 centimeters] clearance between fuselage and ground) were more frequently involved in accidents where the pushback tug or towbar was involved in causation. Of the 11 tug- or towbar-related accidents, eight (73 percent) involved Category B aircraft. Table 1 (page 6) lists the causal factors and their frequency of occurrence in the 46 accident reports.

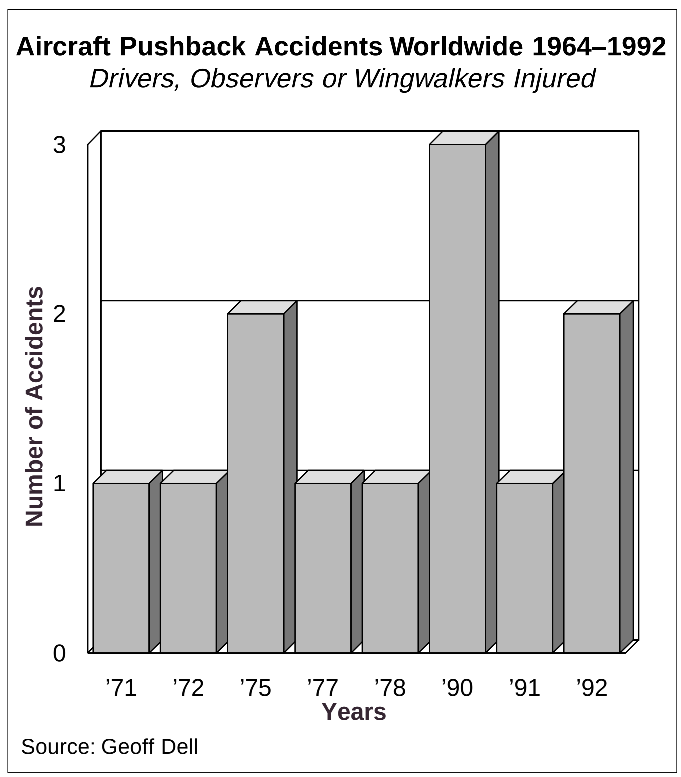


Figure 3

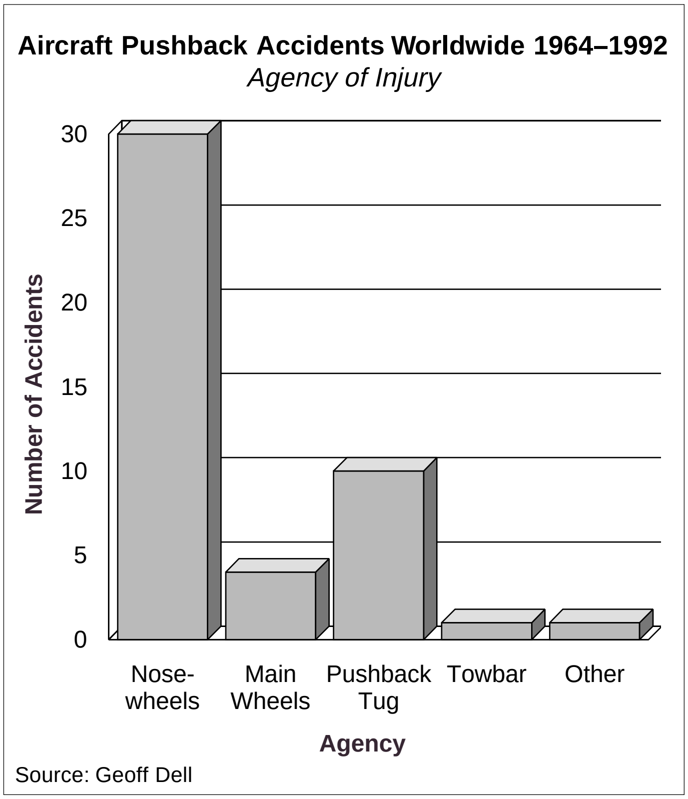


Figure 4

Of the 90 causal factors, 65 attributed accident causation, in part, to the failure of a person involved in the operation. Equipment was involved causally in nine accidents. In one accident poor weather was cited as a factor. In 10 accidents, the operating procedures were involved in the accidents. Five accident reports suggested that the requirement for a person to walk beside the aircraft during pushback should be eliminated, and five accident reports suggested that there was no need for the dispatcher to monitor aircraft engine start.

Table 2 (page 7) shows the number and category of personnel involved in the pushback operations of the airlines represented by the 24 safety professionals who were interviewed.

Half of the 24 airline safety professionals reported that their airlines used Method 6 (see Table 2 for definition of methods) and required as many as three personnel to walk beside the aircraft during pushback. This was the maximum number of personnel routinely exposed to the hazards associated with pushback. No one reported using procedures that required more than four personnel in a pushback crew.

Only five safety professionals reported that their airlines used Method 1 or Method 2 and required no personnel to walk beside the aircraft. Nevertheless, two reported that they switched to Method 1 or Method 2 following pushback accidents that had injured dispatchers.

None of the airlines in the interview group were routinely using cordless communications between the dispatcher and the aircrew. One airline used cordless communications only in poor weather to reduce the likelihood of electric shock to the dispatcher if the aircraft was struck by lightning.

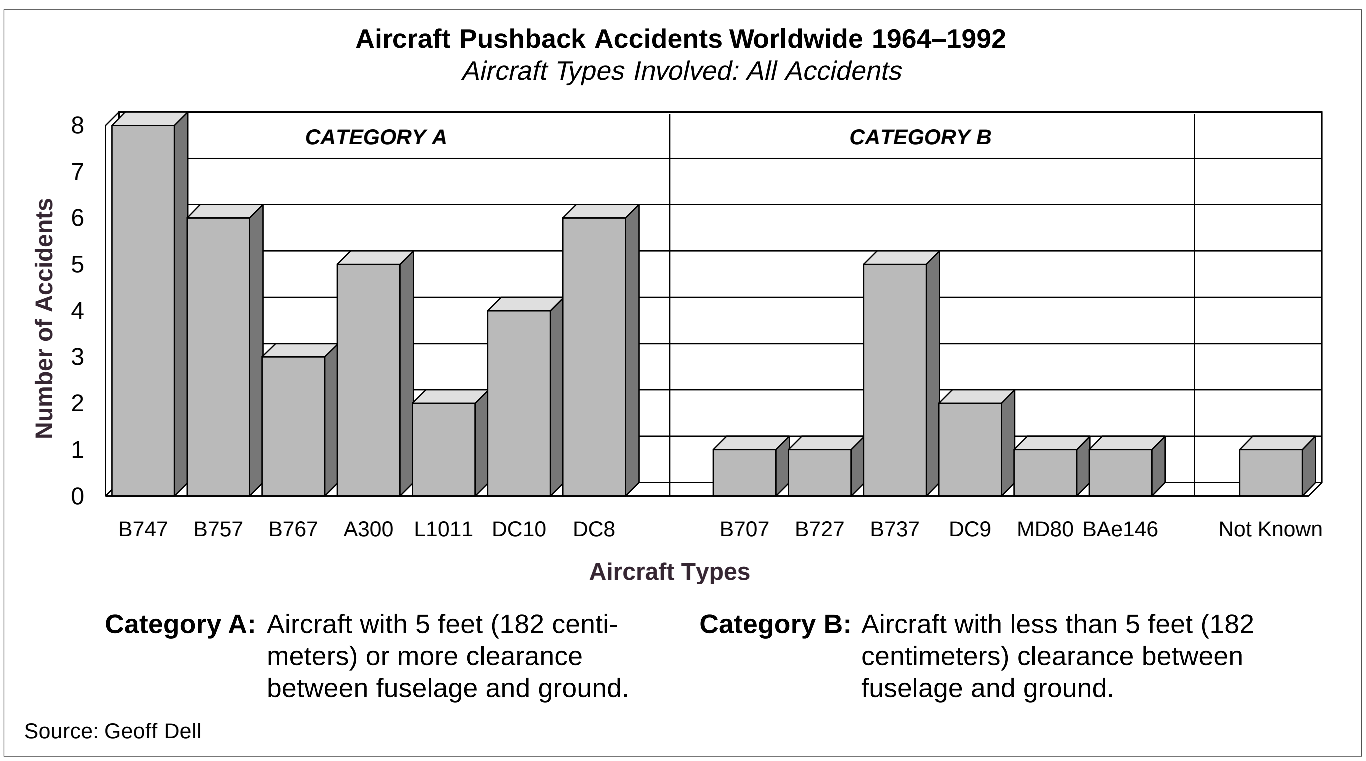
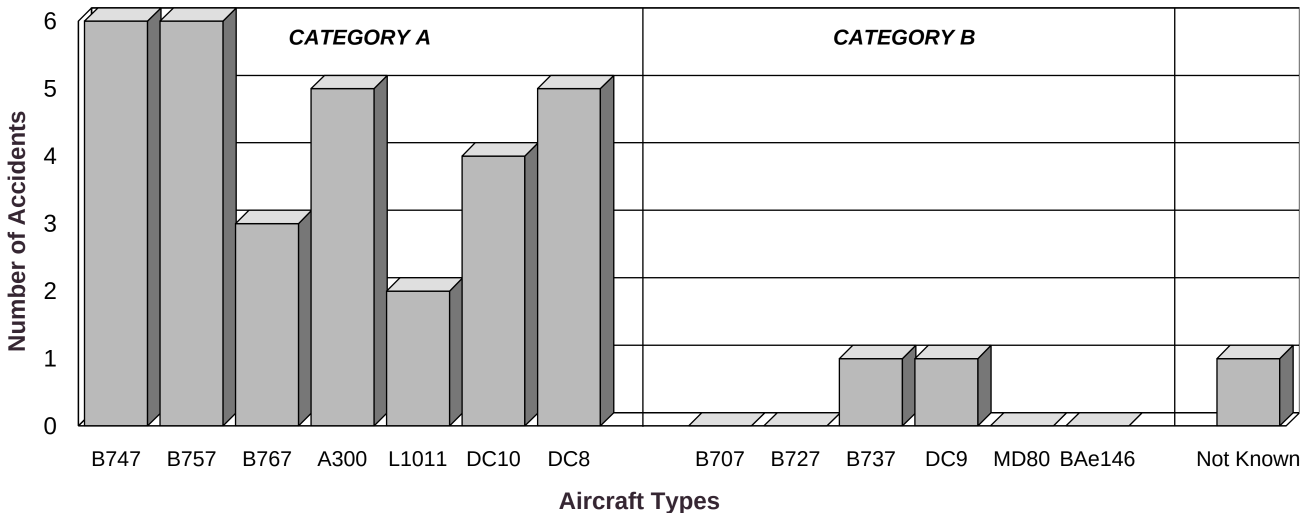


Figure 5

Aircraft Pushback Accidents Worldwide 1964–1992

Aircraft Types Involved: Runover Accidents Involving Nosewheel or Main Wheels



Category A: Aircraft with 5 feet (182 centimeters) or more clearance between fuselage and ground.

Category B: Aircraft with less than 5 feet (182 centimeters) clearance between fuselage and ground.

Source: Geoff Dell

Figure 6

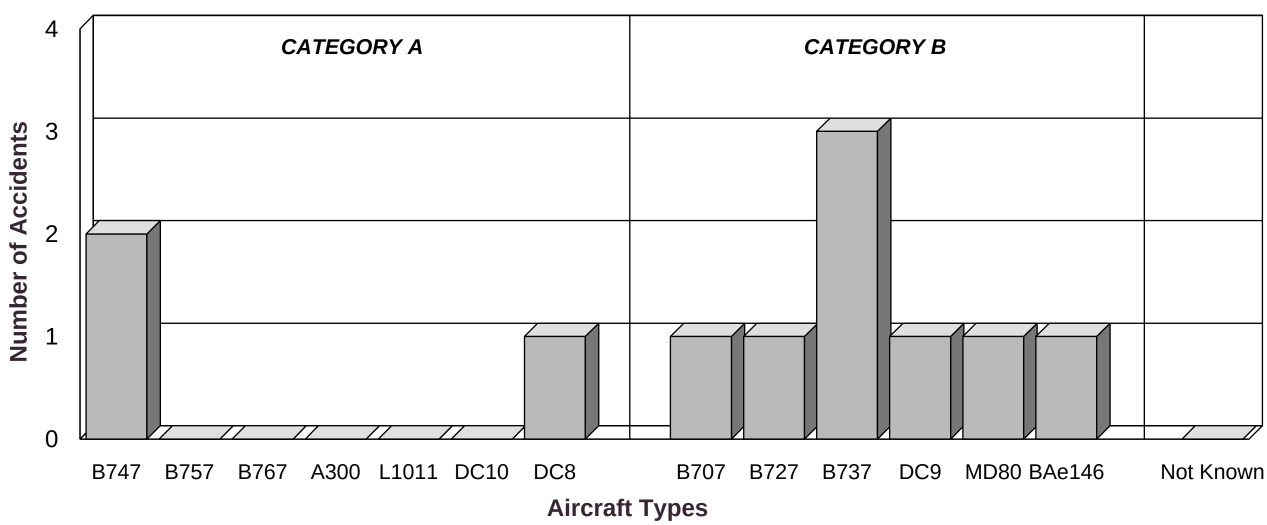
Three airlines had evaluated cordless communications systems and rejected them as unsuitable.

All the airlines that used more than one person in the pushback crew used only hand signals for communication between members of the pushback crew.

Of the nine airlines that either had the driver communicating with the aircrew, or the dispatcher seated inside the pushback tug beside the driver, only four airlines had wired their towbars to allow communication from the aircraft ground interphone panel with the tug crew. The other five airlines allowed the headset cord to

Aircraft Pushback Accidents Worldwide 1964–1992

Aircraft Types Involved: Tug- or Towbar-related Accidents



Category A: Aircraft with 5 feet (182 centimeters) or more clearance between fuselage and ground.

Category B: Aircraft with less than 5 feet (182 centimeters) clearance between fuselage and ground.

Source: Geoff Dell

Figure 7

Table 1
Frequency Distribution of Causal Factors* in 46 Pushback Accidents

Human Factors	Frequency
Failure to follow procedures	18
Person out of position	10
Person stumbled, tripped or fell	8
Inadvertent pushback tug movement	6
Distraction by other extraneous factors	5
Inattention to task	4
Person jumped towbar	3
Person fell from towbar	2
Lack of experience	2
Poor communications	2
Extended duty period	1
Lack of training	1
Haste	1
Connected towbar to wrong end of tug	1
Fault of personnel	1
Subtotal	**65**
Equipment Factors	
Headset cord tangled or trapped	4
Short headset cord	2
Person trapped by towbar	2
Equipment failure	1
Subtotal	**9**
Procedure Factors	
Person required to walk beside aircraft nose	5
Distraction by engineer observation requirements	5
Subtotal	**10**
Other Factors	
Poor weather	1
Not known	5
Subtotal	**6**
Total	**90**

Source: Geoff Dell

* Some accidents involve more than one causal factor.

swing above the towbar and drape between the tug and the aircraft.

Of the 24 airlines, 17 had structured pushback training programs. These programs included instruction about pushback hazards, accident prevention and operational techniques. Seven airlines used only on-the-job instruction for pushback personnel.

Only seven airlines had routine recurrent training or assessment programs. Two airlines provided recurrent instruction only when staff had been absent from pushback operations for extended periods.

All 24 airlines reported having strict procedures for selection of pushback personnel that resulted in the selection of only persons with prior experience in other aspects of aircraft handling.

Twenty-three airlines had situations that permitted days off duty proportional to the duty period worked by pushback personnel. Most common were:

8-hour workday:	5 days on,	2 days off
10-hour workday:	4 days on,	3 days off
12-hour workday:	4 days on,	4 days off

Nevertheless, no airline had limits on the amount of overtime that could be worked, and left to the individual and the individual's supervisor the responsibility of ensuring that rest was adequate.

Only three of the airlines in this study (Lufthansa, Scandinavian Airlines and Swissair) used towbarless pushback tugs. The other 21 airlines used conventional pushback tugs and towbars, but three of them were either evaluating towbarless tugs or planning to use them.

The safety professionals from the three airlines using towbarless tugs all believed that the towbarless pushback tugs reduced the risk of accidents. In addition, the number of people needed in the pushback crew was reduced; the hazard zone around aircraft nosewheels and tug was reduced; and the nosewheels and the tug moved as a single unit.

The 24 airlines had extensive preventive maintenance programs. All pushback tugs, towbars and communications equipment were routinely inspected and maintained.

The majority (17) of the safety professionals believed that ambient conditions were not an influence on safety of pushback operations. Some airlines routinely operated from airports in the Arctic with conditions of ice and snow and temperatures below 32°F (0°C), and also from airports in the tropics with high humidity and temperatures of 104°F (40°C), or dry and dusty desert locations with outside temperatures of 122°F (50°C).

Only four of the safety professionals felt that some ambient conditions (poor weather and poor light) had an adverse influence on pushback safety.

The safety professionals were divided about whether the influence of operational pressures had an adverse effect on pushback safety. The predominant opinion, among the 10 safety professionals who believed that operational pressures did not affect safety, was that aircraft compliance with schedule was measured by the time the aircraft departed the terminal and, therefore, schedule pressure was not applied to the pushback operation. They believed that on-time performance was not affected by speed of pushback and, as a result, pushbacks were conducted with no extraneous operational pressures.

A different opinion was held by the 14 other safety professionals. They believed that haste was a factor affecting pushback safety because schedule disruptions often placed pressures on ground crews to complete tasks more rapidly to regain schedule. When more than the usual number of aircraft were on the ground and required handling, it was suggested, equipment and manpower limitations often placed pressures on personnel. The result was a speedup of work to dispatch an aircraft, so that the crew could move on to the next aircraft. These pressures were believed to influence pushback operations.

The majority of the safety professionals favored engineering solutions to prevent pushback accidents (50 of 74 suggested solutions). Introduction of cordless headsets (16) and towbarless pushback tugs (14) were the preferred solutions of more than half of the safety professionals. Twenty suggested moving the dispatcher into the tug, either by putting the dispatcher in the tug beside the driver (11) or by giving the driver the communications duties and adopting a one-person operation (9).

The predominant procedural solution (14 respondents) was to remove dispatchers from monitoring engine start. Of the safety professionals interviewed, six considered monitoring engine start as an unnecessary distraction. Removal of this requirement allowed the dispatcher to concentrate on the

Table 2
Various Methods Used in Pushbacks by 24 Airlines

	Number in Pushback Crew	Number Required To Walk Beside Aircraft	Method	Number of Airlines
Method 1	1	Not applicable	Tug driver communicating with aircrew	3*
Method 2	2	Not applicable	Dispatcher in tug with driver	2
Method 3	2	1	Dispatcher walking beside aircraft nose	5
Method 4	3	2	Tug driver communicating with aircrew plus up to 2 wingwalkers	2*
Method 5	4	2	Dispatcher in tug with driver plus up to 2 wingwalkers	2
Method 6	4	3	Dispatcher walking beside aircraft nose plus up to 2 wingwalkers	12

* Two airlines reported using procedures that gave the communications role to the driver (i.e., Method 1 and Method 4) on some operations, while they reverted to having a dispatcher walk beside the aircraft on other occasions.

Source: Geoff Dell

operational aspects of the pushback, including aircraft and tug movement. This reasoning was also apparent in the group that believed engine start should be delayed until the pushout was complete (3).

Ten of the safety professionals believed that improving training or supervision was a necessary preventive measure.

Of the 15 dispatchers, 11 believed, contrary to the majority opinion of the safety professionals, that it would not be possible to put the dispatcher in the pushback tug. The dispatchers said that it was necessary to observe aircraft engines during engine start and to advise the aircrew of engine N_1 (fan or low-pressure compressor speed) rotation and of any start abnormalities, such as fires or compressor stalls. They said that it was also necessary to see behind the aircraft to ensure clearance from obstructions, to monitor wingwalkers and to exchange hand signals when necessary.

Only three dispatchers said that they preferred riding on or in the tug. Nevertheless, each expressed the need for the dispatcher to be outside the tug whenever there was a known engine problem or an anticipated start abnormality.

Two dispatchers said that observing engine starts was redundant with modern engine instrumentation technology. They suggested that because aircrews are provided with positive engine N_1 rotation indication in the cockpit, the need for dispatchers to observe engine start during pushback was no longer necessary. Therefore, they argued, engine observation requirements should not be an impediment to putting the dispatcher on the pushback tug.

All five aircrew advised that there was no need for ground staff to advise the cockpit of engine N_1 rotation during startup. This practice was required in early high-bypass-ratio gas turbine engines. These engines were fitted with "blade counters" that could not distinguish the direction of fan rotation and gave aircrew a positive rotation indication in the cockpit even when the fan was rotating backward in tailwinds. Modern engine technology provides accurate positive indication to aircrew, and the dispatcher would only be necessary if the aircraft was being operated with an unserviceable N_1 tachometer. (Pat Brennan, a Sydney-based Rolls-Royce service representative, agreed that there was no longer a need for ground personnel to advise aircrews about N_1 engine rotation.)

Aircrew did not oppose putting the dispatcher in or on the pushback tug while the pushback was in motion, provided that the dispatcher's visibility was not impaired. All aircrew reported that they relied on the dispatcher to ensure clearance behind the aircraft and to give early warning of anything unusual during engine start, particularly fires.

All 15 dispatchers reported that their airlines had extensive initial pushback training programs. These programs included procedural and hazard awareness instruction, in addition to extensive on-the-job training. Nevertheless, none of the dispatchers reported that their airlines had any detailed recurrent training programs. Instead, standards surveillance was maintained as a routine line supervision function.

The majority of dispatchers (11) favored engineering solutions to prevent pushback accidents. Five dispatchers said that there was no problem with pushback systems that require the dispatcher to walk beside the aircraft. This group felt that an experienced dispatcher would be aware of the position of the aircraft and the tug at all times and, thereby, would avoid an accident.

While eight of the dispatchers said that cordless headsets might be an advantage, they expressed concern about perceived difficulties that could be caused by radio interference. Six of the eight dispatchers said that the cordless headset's advantage was to permit them freedom of movement during pushback, while the other two were among the three who favored moving the dispatcher on the tug beside the driver.

All aircrew reported that they relied on the dispatcher to ensure clearance behind the aircraft and to give early warning of anything unusual during engine start, particularly fires.

None of the dispatchers suggested changing to a one-person operation by giving the pushback driver the responsibility for communications with the aircrew.

There was considerable agreement among pushback drivers. All of the drivers said that their organizations used on-the-job instructions for pushback driver training and that none had routine recurrent training programs in place.

All of the drivers said that it would help to move the dispatcher on the pushback tug. It was suggested that dispatchers often walked too close to the pushback tug or nosewheels, and that this diverted drivers' attention away from positioning the aircraft.

Five drivers reported that dispatchers had jumped over the towbar during pushouts. All of the drivers expressed concern about not being in the communications loop (with more than hand-signals) with the dispatcher and aircrew.

George Dial, a Seattle-based Boeing safety manager, said that Boeing had been researching pushback accidents since 1991. A survey of airlines by Boeing had obtained the following pushback accident prevention suggestions:

- Enforce a nose-gear "no-go" hazard zone;
- Enforce a main-gear "no-go" hazard zone;
- Prohibit dispatchers from crossing towbars;
- Improve ramp conditions; and,
- Transfer communications duties to the pushback tug (either by moving the dispatcher to the tug or by giving the driver the additional communications duties).

This study concluded that accidents were often the result of a sequence of events in which no single event was more significant than any other, and removal of any single event was likely to prevent the accident from occurring.[6,7,8]

To understand pushback accident causation and to develop meaningful prevention strategies, it was necessary to look beyond immediate causal factors and to examine how the operation was expected to be performed.

In only five of the 46 accidents, the need was questioned for personnel to walk beside the aircraft during pushback. Moreover, half of the 24 airlines surveyed in this study (Table 2) and 20 of the 32 airlines surveyed by Hayes used procedures that required personnel to walk beside the aircraft during pushback.[9]

The safety professionals agreed that engineering solutions were required to prevent accidents. Minimizing the risk of injury by using towbarless pushback tugs, by moving the personnel away from the aircraft through use of cordless headsets or by putting them in the tug were suggested most often.

The removal of the towbar from the pushback operation, by using towbarless tugs, would prevent injury by eliminating the need for personnel to connect and disconnect the towbar.

Nevertheless, the majority of dispatchers expressed concern at the prospect of being required to ride in the pushback tug because of the need to observe aspects of the pushback, particularly engine start and signals from wingwalkers, and to ensure clearance from obstructions.

The aircrew group supported the need for the dispatcher to see behind the aircraft to ensure clearance and also agreed that the dispatcher should watch for any unusual event during engine start.

Five safety professionals reported that their airlines used pushback procedures that featured either one-person operations with the pushback driver in communication with the cockpit,[2] or two-person operations with both the driver and the dispatcher seated in the pushback tug. None of these airlines reported any difficulties with their operations, nor did they report any pushback accidents since introducing the procedures.

Whether or not a wingwalker was required was largely governed by external factors. Poorly designed aircraft bays, traffic congestion, poor equipment parking and substandard housekeeping increased the need for wingwalkers.

Nineteen of the safety professionals reported that their airlines used wingwalkers whenever these external factors were apparent. The five airlines that used either a one-person operation or two persons in the tug each had expended considerable effort to minimize, almost to zero, the number of occasions when wingwalkers were required. The Scandinavian Airlines' operation at Stockholm's Arlanda Airport in Sweden and the Northwest Airlines' operation at Minneapolis/St. Paul Airport in the United States were cited as two examples of good airport design and housekeeping that removed the need for wingwalkers during pushback.

In accidents that injured wingwalkers, one key factor was the inability of the dispatchers to communicate with them during the pushback. Hand signals were the only method of communication, and this proved inadequate when the accident sequences began. A cordless communication system, with all pushback crew members and the aircrew in the same communications loop, might have provided an opportunity to warn the dispatcher or to stop the pushback, which was not accomplished with hand signals.

The removal of the towbar from the pushback operation, by using towbarless tugs, would prevent injury by eliminating the need for personnel to connect and disconnect the towbar.

The introduction of remotely operated towbarless pushback tugs was considered to be the only significant factor that could reduce the injury risk to pushback drivers. For example, the three accidents, in which drivers were injured, were the result of inadvertent vehicle movement, and the drivers were crushed between the tugs and aircraft. Thus, drivers of towbarless tugs that have driver cabins would remain at risk if inadvertent tug movement occurred.

No need was identified by this study for dispatchers to make engine N_1 calls during engine starts. Airlines with this requirement should remove it from their pushback procedures.

Airlines and airport operators should review the layout of equipment parking and aircraft parking bays to minimize the need for wingwalkers. If cordless communications are available for aircrew-to-dispatcher, the system should also be used to communicate with the wingwalkers. This would bring all pushback crew members and aircrews into the communications loop. If a cordless system is not available, a separate radio system should be provided for wingwalker-to-driver communications. This would help the wingwalker alert the driver of an obstruction to the pushback and the driver could alert the wingwalker if the wingwalker strayed from the correct position at the wingtip.

Because procedural and behavioral controls have failed to prevent all injuries during pushbacks, emphasis must be placed on removing personnel from the areas of risk.

The following recommendations are ranked in order from lowest to highest risk of injury and are based on the number of personnel exposed to the risk. All recommended methods eliminate the need for personnel to walk beside the aircraft while the pushback is in motion. The result is a system with lower injury risk without total reliance on procedural and behavioral control.

Airlines should adopt a method as high as possible in the ranking scale, depending on their pushback equipment and capital resources.

1. Operations with driver-operated towbarless pushback tug; tug driver communicates to aircrew using corded or cordless headset. One-person operation.

   Advantages:
   a) Does not require any personnel to walk beside the aircraft during pushback;

   b) Eliminates the need for manual connection of the tug to the aircraft and removal of the towbar; and,

   c) Permits the driver to remain in the pushback tug to communicate with the aircrew without the need to walk under the aircraft except to disconnect the headset or communications transmitter from the aircraft.

   Disadvantages:
   a) Requires high initial capital outlay for equipment;

   b) Exposes driver to injury while disconnecting communications from the aircraft if aircraft movement occurs; and,

   c) Exposes driver to injury if tug or aircraft movement occurs that results in a collision between the tug and the aircraft.

2. Operations with remotely operated towbarless pushback tug using corded or cordless headset. One-person operation.

   Advantages:
   a) Allows complete removal of the driver from the operation and therefore from risk of injury;

   b) Eliminates the need for manual connection of the tug to the aircraft and manual removal of the towbar; and,

   c) Permits the dispatcher to remain in view of and in communication with the aircrew while remaining in front of the aircraft nose behind the direction of movement, without the need to walk under the aircraft except to disconnect the headset cord or cordless headset transmitter from the aircraft.

   Disadvantages:
   a) Requires high initial capital outlay for equipment;

   b) Exposes dispatcher to injury if the dispatcher walks ahead of the aircraft nosewheel during the pushback; and,

   c) Exposes dispatcher to injury if aircraft movement occurs while disconnecting communications from the aircraft.

3. Operations with conventional pushback tug and towbar; driver communicates to aircrew using corded or cordless headset. One- or two-person operation.

   Advantages:
   a) Does not require any personnel to walk beside the aircraft during pushback; and,

   b) Requires low initial capital outlay for equipment.

   Disadvantages:
   a) May require an assistant to ride in the tug during pushout and a manual disconnect of the towbar from aircraft at completion of pushout;

   b) Exposes assistant to injury if aircraft or tug movement occurs while connecting or disconnecting the towbar and the tug;

   c) Exposes personnel who disconnects communications from aircraft to injury if aircraft movement occurs while disconnecting the communications; and,

   d) Exposes driver and assistant to injury if tug or aircraft movement occurs that results in a collision between the tug and the aircraft.

4. Operations with driver-operated towbarless pushback tug; dispatcher communicates with aircrew using corded or cordless headset from within tug beside driver. Two-person operation.

Advantages:

a) Does not require any personnel to walk beside the aircraft during pushback;

b) Eliminates the need for manual connection of the tug to the aircraft and removal of the towbar; and,

c) Permits the dispatcher to remain in the pushback tug and communicate with the aircrew, without the need to walk under the aircraft except to disconnect the headset or communications transmitter from the aircraft.

Disadvantages:

a) Requires high initial capital outlay for equipment;

b) Exposes dispatcher to injury should inadvertent aircraft movement occur while disconnecting communications from aircraft; and,

c) Exposes driver and dispatcher to injury if tug or aircraft movement occurs that results in a collision between the tug and the aircraft.

5. Operations with conventional pushback tug and towbar; dispatcher communicates with aircrew using corded or cordless headset from within tug beside driver. Two-person operation.

Advantages:

a) Does not require any personnel to walk beside the aircraft during pushback; and,

b) Requires low initial capital outlay for equipment.

Disadvantages:

a) Exposes dispatcher to injury if aircraft or tug movement occurs while connecting or disconnecting the towbar and the tug;

b) Exposes dispatcher to injury if aircraft movement occurs while disconnecting communications from aircraft; and,

c) Exposes driver and dispatcher to injury if tug or aircraft movement occurs that results in a collision between the tug and the aircraft. ♦

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