

US National Transportation Board and Federal Aviation Authority correspondence regarding Korean Airlines Accident, Guam, 1997.

Note: this document has been compiled from the original sources and brought together in a single version for ease of use. All material in 2), 3), and 4) below is as originally obtained from the NTSB website, no editing of content has taken place although minor format changes have occurred.

Steve Last

1) NTSB Guam Accident Report Recommendation A-00-10: FAA action.

Recommendation A-00-10 of this report was that the FAA "Conduct or sponsor research to determine the most effective use of the monitored approach method and the maximum degree to which it can be safely used and then require air carriers to modify their procedures accordingly."

The report was dated January 13, 2000. No significant action appears to have been taken until 2004, when the FAA commissioned some research, the results of which are contained in this document (pp 3-14).

Finally in 2009 some 10 years after the accident the following correspondence is recorded from the Acting Administrator of the FAA, Lynne Osmus. Ms Osmus was appointed as Acting Administrator on January 16 2009 as the previous administrator's term was ending with the end of GW Bush's Presidency and a new Administrator was to be appointed by the incoming President, Barack Obama. Ms. Osmus had previously been primarily involved in and responsible for Aviation Security and Hazardous Materials.

On the date of this letter, Capt. Randy Babbitt, a very experienced retired airline pilot, had been confirmed as Administrator, and he took over 10 days later on June 1st 2009.

2) Letter Mail Controlled 5/29/2009 12:11:01 PM MC# 2090340: Lynne A. Osmus, Acting Administrator, FAA, 5/21/09

To NTSB.

As recommended, the Federal Aviation Administration sponsored a study through George Mason University to determine the most effective monitored approach procedure. The researchers obtained pilots' comments on the strengths and weaknesses of the monitored approach and ways to improve the process. Monitored approaches typically call for the aircraft to be flown by the autopilot in the auto-coupled mode.

The second-in-command (SIC) manages the autopilot and throttles and maintains instrument reference throughout the approach while the pilot-in-command (PIC) seeks visual references to land. If there are sufficient visual references to land, the PIC assumes control of the airplane and completes the landing.

If adequate visual references are not available, the PIC announces a go-around, and the SIC executes the missed approach. The monitored approach was primarily used for Category II approaches.

It was not typically used with Category I approaches as the pilot flying, PIC or SIC, usually retained control through to the completion of the landing. It was also rarely used with Category III approaches, as the PIC primarily retained control through to the completion of the landing. As a result, operators developed different procedures depending on the category of approach to be flown.

The final report of the study, Pilot Perspectives of the Monitored Approach: Results from an Internet Survey, was presented to the FAA in October 2004 (enclosure 1). This report suggested ambiguity among pilots about the meaning of the term, monitored approach, noting that there were several versions of the procedure. Instead of focusing solely on the effective use of the monitored approach method as recommended, the FAA and industry took an alternative approach and refined the requirements, roles, and responsibilities for approaches that emphasize standardization of procedures for the different approach categories.

For example:

1. Advisory Circular (AC) 120-29A, Criteria for Approval of Category I and Category II Weather Minima for Approach (enclosure 2), published in August 2002, recommends operators coordinate their approach procedures to ensure the use of standardized crew policies regardless of the approach type being flown;

2. AC 120-71A, Standard Operating Procedures for Flight Deck Crewmembers (enclosure 3), published in February 2003, includes new guidance on crew monitoring and cross-checking; and

3. FAA Order 8900.1, Flight Standards Information Management System, volume 4, chapter 2, All-Weather Terminal Area Operations (enclosure 4), published in September 2007, has a wealth of information and job aids for FAA inspectors to evaluate and approve low visibility operations.

In addition to airport and aircraft requirements, the operator must develop a stabilized approach concept, detail operating practices, and provide supporting training curricula before approval. We believe that current FAA and industry guidance and associated approval processes provide a high degree of safety and are an appropriate alternative to the recommended action.

I believe that the FAA has effectively addressed this safety recommendation, and I consider our actions complete.

3) NTSB: response.

In response to the first part of this recommendation, to sponsor research to determine the most effective use of the monitored approach method, the FAA sponsored a study at George Mason University to determine the most effective monitored approach procedure. The study obtained pilots' comments on the strengths and weaknesses of the monitored approach and ways to improve the process.

The FAA provided to the NTSB a copy of the final report, Pilot Perspectives of the Monitored Approach: Results from an Internet Survey, which had been presented to the FAA in October 2004.

With regard to the second element of this recommendation, to require air carriers to modify their procedures based on the results of the study, the FAA took an alternative approach and refined the requirements, roles, and responsibilities for approaches that emphasize standardization of procedures for the different approach categories.

The FAA provided examples of its activities in this regard, including the issuance of advisory circulars (ACs) on Category I and II weather minima and on standard operating procedures for flight deck crewmembers. The FAA believes that revisions to Order 8900.1, Flight Standards Information Management System, have also encouraged these activities.

In considering whether the FAA's activities to encourage appropriate use of the monitored approach have been effective in achieving the intent of the second element of this recommendation, the NTSB has generally found that carriers are increasingly adopting and using the monitored approach technique.

Therefore, the NTSB believes that the actions of the FAA have constituted a satisfactory alternative response and, consequently, Safety Recommendation A-00-10 is classified CLOSED--ACCEPTABLE ALTERNATE ACTION.

4)

International Journal of Applied Aviation Studies, 5 (2), 321-334. Technical Note: Wochinger, K., and Boehm-Davis, D. A. (2005)

Pilots' Perspectives on the Pilot-Monitored Approach: Findings from a Web Survey.

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Abstract:

A type of instrumented approach referred to as the pilot-monitored approach may have safety advantages over standard instrumented approaches, but there are insufficient data to determine the extent of its value. Likewise, there are no federal standards or guidelines in regards to its training or procedures, nor is information readily available on its practice. However, the catastrophic crash of Korean Air Flight 801 highlighted a need for research on the pilot-monitored approach. This paper presents the results of an initial research effort designed to obtain basic information on issues such as the frequency of its use and its perceived value. The research used a questionnaire posted on the World Wide Web to survey professional pilots about their experiences with and knowledge of the pilot-monitored approach, as well as their assessments of its safety and utility. The analysis focused on responses from 205 pilots who held either a commercial or an airline transport certificate. Results suggested that many pilots view the

pilot-monitored approach as a safe and valuable means of executing instrumented approaches. However, the findings also showed that there is much uncertainty about very basic aspects of the pilot-monitored approach, including its definition, role in aircraft with auto-land capability, and the existence of federal policy toward it. The results suggested that further investigation is warranted to determine whether there is a need to standardize training and/or procedures for the pilot-monitored approach.

Pilots' Perspectives on the Pilot-monitored Approach: Findings from a Web Survey

The pilot-monitored approach is a means of executing an instrumented approach in which one pilot focuses on the cockpit instruments that display the aircraft's deviation from its intended path, while the other pilot scans the external environment for signs of the runway. The approach is designed to be executed when the runway environment is obscured by poor visibility conditions and it is desirable or necessary to provide resources for the crew to acquire visual reference to the runway. Currently, there is relatively little information available on the pilot-monitored approach, including basic issues such as the frequency of its use, criteria for training, and pilot opinion of its safety and usefulness. However, the catastrophic crash of Korean Air (KAL) Flight 601 in 1997 highlighted a need to improve understanding of the pilot-monitored approach.

KAL Flight 801, operating in United States airspace as a regularly scheduled international passenger service flight, was attempting to land at Guam International Airport when it crashed into high terrain three miles short of the runway. The approach was executed under difficult circumstances, at night with rainy weather and a fatigued captain. The crew was executing the Instrument Landing System (ILS) approach to runway 6 Left. The ILS is a precision approach and landing aid that consists of a localizer, a glide slope, marker beacons and an approach light system (Nolan, 2004). The glide slope provides vertical guidance and the localizer provides lateral guidance to the pilot in lining up the plane with the runway. In this case, however, the glide slope portion of the ILS on runway 6 Left was out of service for reconstruction (National Transportation Safety Board, 2000). Shortly after being cleared to land, the airplane crashed into hilly terrain. The crash and a post crash fire destroyed the aircraft and killed 228 out of the 254 people on board.

The NTSB attributed the probable cause of the accident to the captain's failure to adequately brief and execute the non-precision approach, as well as the first officer's failure to monitor and cross-check the captain's execution of the approach (NTSB, 2000). The NTSB noted that the flight crew did not use the pilot-monitored approach. Rather, the Captain handled the flight controls and assumed responsibility for scanning the external view during the approach and final descent. Among the dozens of recommendations issued by the NTSB as a result of its investigations was one to, "Conduct or sponsor research to determine the most effective use of the monitored approach and the maximum degree to which it can be safely used and then require air carriers to modify their procedures accordingly" (p. 148).

Description

The pilot-monitored approach is designed to be used in poor visibility conditions, which intensify the difficulty in switching visual attention between the instrument landing display and the runway environment. Further, weather conditions that frequently accompany poor visibility, such as surface winds, rain, and/ or snow, are likely to

increase pilot workload during the approach and landing. The monitored approach allows the landing pilot to focus on the external runway environment by freeing him or her from the task of following the instruments. This objective is met by tasking one pilot (the Non-Landing Pilot) with following instruments until decision height (the flight altitude at which a landing decision needs to be made), and tasking the other pilot (the Landing Pilot) with acquiring visual signs of the runway. The Landing Pilot, who has maintained visual reference of the runway, makes the decision whether to land or execute a go-around procedure. In the event of a landing, the Landing Pilot assumes control of the airplane and guides the aircraft to the runway. In the event of a go-around procedure, the Non-Landing Pilot maintains control and executes a go-around procedure. Frequently, the captain is the Landing Pilot and the Non-Landing Pilot is the first officer. The pilot-monitored approach contrasts with standard means of executing approaches in which the Landing Pilot scans both the flight controls and the external runway environment, and maintains control of the aircraft during both the approach and landing.

Scarce Information Available

A literature review revealed little data on the pilot-monitored approach, although there is some information available in Federal Aviation Administration (FAA) Advisory Circulars, Aviation Regulations, and the Aeronautical Information Manual (AIM). However, these documents do not directly address the pilot-monitored approach nor define official FAA policy toward it. Potential sources of information are the training manuals and standard operating procedures of air carriers. However, these sources are proprietary and their acquisition is difficult. Because the procedure has inherent room for variations, such as in the number of altitude call-outs or communication between the pilots, it is possible that carriers vary in their procedures or policies in regards to the pilot-monitored approach. Unfortunately, this information is not readily available.

Post-crash reports may be the best available source of information. For example, the report of the NTSB investigation into the crash of American Airlines Flight 1340 in Chicago in 1998 describes the policy of American Airlines for Category (CAT) II approaches (NTSB, 2001). According to the report, the American Airlines 727 Operating Manual states that CAT II approaches are to be flown with the autopilot coupled to the ILS until decision height. The CAT II procedure requires the First Officer to take the role of the Flying (Non-Landing) Pilot who "remains on instruments throughout the approach and landing, and makes all normal callouts below 1,000 feet" (p. 22). When the Captain visually acquires the runway and is ready to take control of the plane and complete the approach and landing visually, he or she will "push the first officer's hand from the throttles and call out 'I've got it', indicating intention to land" (p. 22).

Research Questions

Due to the scarcity of information available on the pilot-monitored approach, the survey research reported below was an initial effort to obtain information from pilots about their experiences and opinions on the monitored approach. The survey was designed to address basic but key issues, including:

- Pilot opinion of the safety and utility of the pilot-monitored approach.
- Pilot experiences using the pilot-monitored approach,
- Pilot recommendations about its improvement.

Method

The survey included closed and open-ended questions in regards to the pilot's familiarity with the pilot-monitored approach, knowledge of its procedures, and awareness of FAA policy towards it, as well as its perceived safety, difficulty, and training requirements. The survey included open-ended questions about its strengths and weaknesses, and areas for improvement. In this way, the survey served as a means for pilots to voice their opinions and describe their personal experiences in regards to the monitored approach. The research team developed the survey with the help of several professional pilots, both active and retired, and piloted the survey with several professional pilots.

Recruiting participants for the survey consisted of two parts. First, recruitment letters were mailed to twelve pilot unions, predominantly of the major carriers, and about sixty non-union pilot organizations, flight schools and university aviation departments informing them of the survey's existence and encouraging their pilot members to complete it. Second, notices were posted on internet pilot forums about the survey. In each of these cases, a code was provided that would allow pilots to enter the survey web site and submit their responses.

The survey was posted on the World Wide Web from April 2004 through September 2004. There were two rounds of data collection, the first from April to June, and the second from July to September. The second round had fewer survey items than the first because feedback suggested that the survey was somewhat too long.

Results

Respondents

The design of the web site required visitors to enter a code to navigate to the survey. Visitors who entered a code may have opted not to take the survey, or may have started to take the survey but not completed it. The analysis only used data from individuals who completed all or nearly all of the survey and whose comments revealed that they understood the definition of a pilot-monitored approach. Data from individuals who completed a page or two were not included in the analysis. In addition, surveys from individuals who revealed through their comments that they were referring to a type of monitored approach performed by Air Traffic Controllers were not included in the analysis. The final data set consists of 205 records.

Table 1 summarizes the pilots' background in terms of their airline certificates held and their years of experience. The majority of pilots (n=133) exclusively held airline transport airman certificates.

Table 1
Pilot Background in Terms of Airman Certificate and Years of Experience

Years Experience	Commercial	Airline Transport	Holds Both Certificates	Total
1-5 years	17	7	4	28
6-10 years	6	1/	5	28
11-15 years	1	10	5	16
16-20 years		15	5	20
more than 20	4	83	8	96
Total	28	133	27	191*

*Fourteen pilots did not provide information about their certificates or years of experience.

Familiarity with the Term and Procedures

The first page of the survey focused on familiarity with the pilot-monitored approach in terms of its meaning, procedures, and FAA policy. Most of the respondents indicated that they were familiar with the term and its procedures. For example, in response to the question, "How would you rate your familiarity with the term monitored approach." 79% of respondents (n=162) said they are "pretty familiar" or "very familiar" with the term; 7.3% of respondents (n=15) said that they are "minimally" or "not at all familiar" and 13.7% (n=28) said they are "somewhat familiar." Similarly, more respondents agreed (77.6%, n=159) than disagreed (13.7%, n=28) with the statement, "In the aircraft that I have flown as a professional pilot, I had a good understanding of the procedures required to execute a monitored approach," and 8.8% (n=18) were not sure. Thus, the majority of pilots who completed the survey indicated that they were familiar with the term and the procedures of the pilot-monitored approach. This result is not very surprising considering that individuals not familiar with a topic may be unlikely to pursue a survey about it, and the findings should be interpreted in the context of this particular sample of pilots.

Confusion about FAA Policy

The results showed that there is uncertainty among the surveyed pilots about the existence of an official policy on the pilot-monitored approach (Note: there is no official FAA policy). Pilots were asked to agree or disagree with the statement, "The FAA requires IFR [instrument flight rules] pilots to follow the monitored approach method under some circumstances." The responses varied: 36.6% (n=75) said they were not sure, 37.5% (n=77) agreed with the statement, and 25.9% (n=53) disagreed with the statement. It is noteworthy that the sample of pilots, who for the most part described themselves as being familiar with the pilot-monitored approach, was uncertain about FAA policy. This finding suggested that there might be uncertainty about FAA policy in the wider aviation community.

Echoing this state of uncertainty is the fact that 49% (n=101) of the pilots agreed with the statement that, "The term monitored approach means different things to different pilots;" 25.9% (n=53) were not sure; and 23.4% (n=48) disagreed. Three respondents did not answer the question. One source of confusion lies in the fact that Air Traffic Control (ATC) can monitor an approach and inform the flight crew when the aircraft deviates from the approach track.

Ambiguity of the Term

The ambiguity of the term is illustrated by the fact that 17 individuals who participated in the survey believed that the monitored approach referred to ATC monitoring aircraft. This fact became apparent from the comments that they submitted at the end of the survey, in which they discussed ATC procedures. In addition, pilots who were familiar with the pilot-monitored approach were not necessarily familiar with the term. For example, one pilot noted that he or she "wasn't aware that it was labeled as such" until taking the survey, yet this pilot's responses indicated that he or she had trained and executed the pilot-monitored approach. One pilot suggested that the term "Pilot-Monitored Approach" is "a better way" to describe the method than simply "monitored approach." It is possible that the term "pilot-monitored approach" would clarify its meaning by distinguishing it from ATC-monitored approach.

Current Use

An important but unanswered question concerns frequency of use. To help answer this question, the survey asked pilots to agree or disagree with the statement that. "Pilots rarely use the monitored approach method in commercial or business aviation;" 37.5% (n=77) agreed; 36.6% (n=75) were not sure; and 25.9% (n=53) disagreed. The range of responses mirror the ambiguity and uncertainty reflected in the distribution of responses to the question about FAA policy, suggesting that there is incomplete information about this method of precision approaches.

The survey asked pilots to indicate "the number of times that I have executed a monitored approach while flying." The responses were widely distributed: 35.1% of pilots (n=72) never executed a monitored approach; 7.8% (n=16) executed the approach one or two times; 6.3% (n=13) executed the approach three to four times; 18.5% (n=38) executed it several times; and 32.2% (n=66) executed it dozens of times. About as many pilots in the sample never executed a monitored approach as those who executed one many times. Unfortunately, the data did not reveal the source of this difference, but it is an interesting result in view of the finding that most of the pilots who completed the survey stated that they were familiar with monitored approach procedures.

It is reasonable to ask whether the pilot-monitored approach is relevant in today's aviation environment due to technological advances such as autoland capability. The pilots were asked to agree or disagree with the statement "Knowing how to execute a monitored approach may have been important in commercial aviation in the past, but it is no longer important." Although a majority of the pilots (75.6%; n=155) disagreed with the statement, 34 pilots (16.6%) were not sure and 15 pilots (7.4%) agreed (and one did not answer the question). This finding suggested that, for this sample at least, the pilot-monitored approach maintains its relevancy.

The responses indicated that the monitored approach is used to some extent and is relevant in today's aviation environment. The question then becomes, who is using it? To help identify the types of companies using the monitored approach, the survey asked pilots who had trained for and/or executed a monitored approach, to indicate the type of company for whom they worked at the time. The results suggested that a broad spectrum of organizations train pilots for the monitored approach or include it in their procedures, including:

- Major airlines
- Regional airlines
- Corporate flight departments
- Flight schools
- Cargo carriers.

Perceived Safety and Difficulty

To estimate whether pilots consider the monitored approach to be safe, the survey asked pilots to rate its safety relative to other types of precision approaches. By "other precision approaches," the survey defined any procedure a crew might follow when using precision instruments during the approach and landing. The majority of pilots indicated that it is a safe way to execute a precision approach, with 29.3% (n=60) rating it as "much more safe;" 30.7% (n=63) rated it as "some- what more safe;" 30.7% (n=63) rated its safety about the same as a standard precision approach (7.8% (n=16) rated it as "somewhat less safe" and 1.5% (n=3) rated it as "much less safe"). Regarding its difficulty, most pilots (47.8%, n=98) rated it as "about the same" as other precision approaches. Although the second largest percentage of pilots (31.7%, n=65) rated it as easier, many pilots (19.5%, n=40) rated it as harder to execute; two respondents did not

answer this question. These results should be interpreted with caution, because a pilot's opinion on this question is likely to be dependent upon his or her experience and training.

The purpose of the pilot-monitored approach is to allow each pilot to focus on his or her particular task. However, there may be difficulties inherent in this method, with some aspects being particularly difficult. Determining which aspects are more problematic for the crew is relevant to developing training protocols and procedures. To gain information about this issue, the survey asked those pilots who had executed a monitored approach to select its "most difficult" from a list of four possibilities. (Only pilots who had executed a monitored approach were asked to complete this question.) One hundred and forty-five pilots provided an answer (sixty did not), as shown in Table 2. Although a minority of respondents (37.2%; n=54) selected "all aspects are easy" as their response, most of the respondents (60%; n=87) selected one of the possibilities as being the most difficult.

Table 2
What aspect of the monitored approach do you think is the most difficult?

Responses	Percent	Number
Visually acquiring the runway	16.1%	33
Briefing the crew before the approach	10.7%	22
Determining whether to go-around or land	9.3%	19
Following the Instruments - being heads down	63%	13
None- all aspects are difficult	28%	4
None -all aspects are easy	37.2%	54

Importance of Training

The results suggested that the respondents consider training essential to the safe execution of monitored approaches. When asked to indicate what degree of discomfort they would feel if they were to execute a monitored approach with a crew that had no training on the monitored approach. 32.2% of the respondents (n=66) said they would have "high discomfort" and 42% (n=86) would have "some discomfort," whereas 2% (n=4) would have "no discomfort" and 11.2% (n=23) would have "little discomfort." (Some pilots (12.7% n=26) were not sure.) Several pilots commented on the need to improve training and the importance of training. One pilot stressed that "practice, practice, practice" was necessary to improve the execution of monitored approaches.

Pilots' Comments on the Monitored Approach

The last page of the survey asked pilots to submit comments, limited to 250 words, for each of the following items:

1. Describe a difficult monitored approach that you have experienced.
2. List the strengths of the monitored approach.
3. List the weaknesses of the monitored approach.
4. In your view, how can the monitored approach method be improved?

This section provided an opportunity for pilots to submit ideas in their own words on topics that may not have been covered by the earlier survey items. One hundred and five pilots (51%) submitted comments. The comments are summarized below in Tables 3 through 8. Each table lists the comments in one column and the number of pilots making that comment is shown in the "numbers" column.

Difficult Conditions

The pilots described many conditions and/or factors that render monitored approaches unusually difficult. Difficult conditions fell into those that are either externally controlled or located, such as weather (see Table 3), or those that are related to crew management and actions (see Table 4). Other difficulties are inherent in the procedure itself (see Table 5):

Table 3

External Conditions Associated With Difficult Monitored Approaches

External Conditions	Number
Combined conditions of low visibility and strong wind	11
Low visibility	5
Windy conditions	2
Autoland not available	2
Airport location - high terrain	1

Table 4

Crew-Based Problems Associated With Difficult Monitored Approaches

Crew-Based Problems	Number
Weak / inexperienced crew member	3
Insufficient briefings	3
Crew member called for a landing before visually acquiring the runway	1
Pilot-in-Command became distracted at about 200 feet above minimums	1
Crew was slow to reconfigure aircraft for the missed approach	1
Monitoring pilot "panicked"	1
Pilot overshot the ILS	1
Pilot Monitoring distracted himself and the other pilot by calling ATC rather than on focusing on missed approach procedure	1
Pilot Monitoring hesitated to make the call for a landing or a missed approach	1
Late handover of controls	1
Handed over controls several times	1

Table 5

Difficulties Inherent in Monitored Approaches

Procedures	Number
Swapping controls at decision height	1
More concentration required	1
Division of duty	1

Strengths of the Pilot-monitored Approach

The pilots provided characteristics of the monitored approach that they consider strengths, shown in Table 6. Among the strengths cited by many respondents was its effect on crew coordination. Executing a pilot-monitored approach requires that the crew be tightly coordinated and disciplined. Similarly, executing the approach requires that the crew make explicit the roles and responsibilities of each pilot. One pilot stated that

properly executing a monitored approach means that each pilot will be "completely in the loop." This sharing of responsibility also has the benefit of reducing individual workload.

Table 6
Strengths of the Monitored Approach

Grouped Comments	Number
Leads to clear and specific task assignments for each crew member	17
Facilitates the transition to visual reference/ minimizes transition time from instruments to external cues	16
Provides the ability to acquire the visual reference necessary for landing	12
Increases ability of Pilot Flying to attend to Instruments (develop scan and recognize deviations)	11
Forces crew to be prepared for missed approaches	8
Forces crew to be tightly coordinated	6
Pilot with visual reference lands the airplane	6
Enhances situational awareness for the Pilot In Command	5
Provides strong back-up between crew members	5
Crew resource management (non specific)	4
Each crew member performs the task for which s/he is most experienced	3
Easy to execute	3
Lowers individual work load	3
Safer than other approaches	3
Eliminates need to switch between Instruments to outside	2
Increases the ability of crew to pay attention to tasks	2
Enables the Pilot Flying to focus exclusively on the Instruments	2
Enables positive control of the aircraft	1
Enhanced situational awareness	1
Forces crew to have thorough briefings	1
Minimizes the risk of the aircraft pitching up when the crew transitions from instruments to visual reference	1
No change in control at critical point	1

Weaknesses of the Pilot-monitored Approach

Table 7 summarizes pilots' comments about the weaknesses of the monitored approach. In many ways, the pilots' comments revealed that its very strengths could also be viewed as vulnerabilities. For example, the requirement that the crew be well coordinated throughout the procedure means that breakdowns in communications or inadequate briefings can have particularly negative consequences. Another perceived weakness is the changing of aircraft controls in close proximity to the ground, an aspect that was noted by several pilots as an inherent risk in the approach.

Table 7
Weaknesses of the Monitored Approach

Potential Weaknesses	Number
Change of aircraft control at critical stage and close to the ground	22

Requires that crew be well trained	12
Requires that crew be well coordinated	8
Requires a good briefing	6
Requires that the Second-in-Command be proficient	3
The transition to visual reference is still necessary	3
Not satisfying for the Not Landing Pilot to fly, but then not land, the aircraft/ the Not Landing Pilot may not be willing to cede control to Landing Pilot	3
Short time to acquire visual reference to runway	3
Tempting to look away from the Instruments to outside	2
There is no standard for training	2
Forces the Captain to watch activity of the First Officer very closely/ Restricts ability of the Captain to get additional help from the First Officer	2
It 'divides the cockpit'	1
Can be distracting when company procedures require many "call outs"	1
Cannot be performed in combination with a HUD	1
Creates more workload	1
Landing Pilot cannot cross-check with course and glideslope	1
The pilot-monitored approach may not be necessary	1
Not all aircraft are properly equipped	1
Requires that companies have specific procedures	1

Improvements

Pilots recommended a diversity of improvements for the monitored approach, as shown in Table 8. Many pilots approached this question by suggesting improvements through training and standardization, whereas other pilots recommended improvements to the procedure itself. At least 19 pilots suggested that either more training or the standardization of training would be an improvement, and several pilots recommended that more practice or regular use is required. In addition, several pilots called for stronger guidelines, checklists, and procedures. Another pilot noted that standardization might be important especially for crews that have not received formal training on the monitored approach. One pilot recommended that an Advisory Circular be published. In contrast, a few pilots suggested that the monitored approach is no longer needed.

Many respondents made specific recommendations in regards to the procedure. For example, several pilots advocated that the monitored approach could be improved with the integration of Heads-up Displays (HUDs) in the cockpit. Interestingly, some pilots recommended a HUD for the Pilot Not Landing, whereas other pilots suggested that a HUD would support the Pilot Landing by improving the ability to capture the outside environment more quickly and accurately. A few pilots called for the use of an autopilot until the aircraft reaches decision height, but others flatly stated that the monitored approach should not be used with an autopilot. In fact, several pilots suggested that the monitored approach is not needed with today's flight guidance systems. In contrast, several pilots said because of the effectiveness of the monitored approach, they could not think of any ways to improve it. For example, one person wrote, "If used properly, it is an excellent technique." Another commented that she or he could not think of an improvement because, "It's brilliant."

Table 8
Pilots' Recommendations for Improving the Monitored Approach

Ways to Improve the Monitored Approach	Number
Integration with HUDS	12
Increase training requirements	7
Require that all crews be trained on It	6
More frequent use	4
Standardization	4
Standardize training	3
Inform pilots of Its value in reducing crashes into terrain (CFIT)	2
Require that all/most airlines use it	2
Use of autopilot	2
Use of Enhanced Viston Systems	2
Do not use with coupled autopilots	1
Made mandatory for all non-precision approaches	1
Only have call outs for non-normal things such as "No Flare" or "No Rollout"	1
Publish strong guidelines and checklists	1
Use standardized missed approach procedures	1
Stronger crew discipline	1
Train for it using simulators	1
Use autopilot until Decision Heigh*.	1
Use the word 'Decide" at "minimums" to promote the act of either committing to land or following a missed approach procedure	1

Conclusions

The results identified several key aspects of the pilot-monitored approach. Specifically, the results showed that there is ambiguity about the meaning of the term "monitored approach" as well as uncertainty about FAA policy toward it. Nonetheless, the survey data strongly suggested that the monitored approach has a role in commercial aviation. Further, the sampled pilots in general view it as a safe and useful procedure. The results showed that aviation organizations provide some training for the monitored approach and that pilots use monitored approach procedures. Clearly, changes in technology have not made it obsolete. It remains unknown, however, what priority the monitored approach holds in the training protocols of carriers and companies. If monitored approaches are conducted very infrequently, as seems likely, then carriers and companies may not view training for it as cost-effective. However, the fact that it is executed infrequently and under difficult circumstances points to a need for training.

The results of the survey provided an initial glimpse into aspects of the monitored approach upon which further research can be built. The results revealed that there are many issues to be resolved or even identified. In general, directly asking pilots for their opinions through an Internet survey was a relatively cost-effective and fruitful endeavor that helped to address the research objectives. However, there are limitations to the research that should be kept in mind. For example, the survey could not confirm the status of respondents or randomly select the respondents. Likewise, as in other types of surveys, some respondents may doubt the security of the information that they provide, and, for this reason, may have been unwilling to share information that is sensitive or critical. In addition, although some organizations showed an eagerness to help and recruited dozens of pilots to take the survey, other organizations were not as responsive. One of the most successful avenues of contacting pilots was through internet forums, including Bluecoats, Landings, and the AirlineCrew lists, a finding which suggests that pilot forums may be a valuable resource in future research efforts. Important follow-up questions include the following:

- Should the FAA mandate the use of the pilot-monitored approach for special situations?
- Should the FAA mandate training or standardize training for the pilot-monitored approach?
- What type of training is most effective?
- What type of criterion should be applied for training of the pilot-monitored approach?
- What, if any, aspects of the monitored approach require improvement?
- Are there types of aircraft for which the pilot-monitored approach is more important? If so, on what basis can this classification be made?

To pursue these questions, one avenue would be to conduct an in-depth survey with a randomized sample that represents the nation's population of professional pilots. A national, comprehensive survey would counter some of the limitations of the current data set and would provide details about training procedures, safety advantages, and possible improvements. It is important to identify the circumstances when the pilot-monitored approach should be used. Another fruitful endeavor would be to conduct empirical, simulator-based research in order to identify useful training protocols as well as variations in procedure that improve performance and safety in the pilot-monitored approach.

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