THE USE OF ASRS INCIDENT REPORTS IN AQP TRAINING

Susan J. Mangold
Battelle
Columbus, Ohio

F. Rowena Morrison
Battelle ASRS Office
Mountain View, California

Stephanie M. Frank
Battelle ASRS Office
Mountain View, California

INTRODUCTION

One of the goals of the Advanced Qualification Program (AQP) is to encourage the development of innovative training programs that will improve the overall effectiveness of flight crews working in an increasingly complex operational environment. Revisiting the training process provides an opportunity to introduce, or expand upon, alternative methods of presenting and structuring information within a curriculum. In particular, crew training programs can be designed to move away from an emphasis on memorization in order to help students learn to *apply* the information they are expected to know.

Requiring students to use information to solve problems offers many benefits. First, there is likely to be greater transfer to the operational environment where simply remembering facts is unlikely to be sufficient. In addition, students become active participants in the learning process, which is likely to challenge them to greater levels of learning. Students can also be expected to achieve a greater understanding of the information as they become aware of the range of applications to which that information has relevance. Finally, applying information has been shown to lead to greater retention of that information (Bransford, 1979).

One approach that encourages the application of information is scenario-based training. This type of training is hardly new to the aviation industry. Many carriers already use it in the form of LOFTs and LOEs. The goal is to introduce real-world conditions that require the application of a range of technical and flight management skills. Students are given the opportunity to practice and test the effectiveness of a variety of skills, some of which may never be needed until they find themselves in a non-normal flight situation. LOFTs and LOEs allow them to utilize these skills in the safety of a flight simulator.

Scenario-based training can also be extended to other parts of the curriculum. Ground school is an obvious candidate. The emphasis in most ground schools, especially in a qualification curriculum, is on systems knowledge. Ground school often focuses on ensuring that students come away with the variety of facts and figures required to safely operate the aircraft. However, this information is not of much help unless the student is able to apply it appropriately to actual flight situations. Applying information requires a different set of cognitive processes and skills than simple memorization. In particular, problem solving skills and awareness of effective resource management are critical, and if students work in teams, the opportunity for practicing communication skills is also provided. In effect, two objectives are solved by using scenario-based training in ground school: students acquire the technical information needed to fly the

airplane while, at the same time, practicing many of the flight management skills that contribute to a safe flight.

FTD and simulator training also can benefit from scenario-based training. The Model AQP program, currently being developed by Battelle (Mangold & Neumeister, 1995), builds on the use of event sets as the means for constructing LOFT scenarios (Hamman, Seamster, Smith & Lofaro, 1993) by using coherent fight situations, called events, as the basic units for building a flight training curriculum. An event consists of a task (a maneuver, such as an approach, or a set of procedures, such as the engine start checklist) combined with a set of conditions under which that task is to be performed (e.g., no flaps). The combination of task and conditions defines a situation which encourages the use of both technical and flight management skills. In particular, an event must be accurately assessed to determine the characteristics of the situation that must be handled, and resources that can be used to manage the situation must be identified. The focus on individual events enables their use as clearly defined units of activity that can introduce crews to the unique demands of a new aircraft during qualification training.

Scenario-based training holds great potential as a tool that can expand students' proficiency in using the information they learn throughout the entire curriculum. However, the value of scenario-based training is clearly contingent upon the quality of the scenarios themselves. Developing them will require some creativity on the part of those responsible for designing the curriculum. A tool that might be helpful in creating effective scenarios is the Aviation Safety Reporting System (ASRS).

THE AVIATION SAFETY REPORTING SYSTEM

ASRS was developed to serve as a repository for incident reports that are voluntarily submitted by pilots, air traffic controllers, flight attendants, and other individuals participating in the National Airspace System (NAS). These reports provide the reporter's view of what took place during the incident and the causal conditions thought to have caused it. Not surprisingly, they have served as a rich source of data for researchers interested in a wide range of problems, from specific problems plaguing a limited part of the NAS (e.g., poorly named VORs) to broad issues affecting the overall safety of the system (the continuing problem of altitude deviations).

ASRS is a logical source of candidate scenarios that could be included in an AQP curriculum. However, although most members of the aviation community are familiar with ASRS, very few have actually used the database to conduct searches. The availability of recent ASRS reports on CD-ROM will change this. The ability to conduct their own searches, and the flexibility to simply browse through the reports, provides an unprecedented opportunity for curriculum developers to utilize incident reports in their curricula.

POSSIBLE ROLES FOR ASRS INCIDENT REPORTS

ASRS reports may be used in a number of different ways. First, the curriculum designer might wish to identify the most common types of problems occurring in the NAS as a whole or for some subset of the population (defined, for example, by aircraft or pilot type). Identification of common problems allows additional training to be incorporated into the training curriculum. If the carrier is experiencing a large number of problems of a particular type (e.g., altitude deviations), the curriculum designer might also wish to investigate the most common causes of a particular problem. These causes might be a useful discussion item for inclusion in a continuing qualification ground school. Or the causal conditions might be incorporated into a LOFT scenario to allow crews to experience these conditions in a training environment. The types of uses for incident reports depends upon the specific training objectives of a curriculum. Some examples are provided below.

Qualification Ground School

Given the focus on aircraft systems knowledge in qualification ground school, incidents describing the consequences of mishandling specific types of malfunction might be useful to the ground school instructor. These reports can serve as examples of the types of situations that could be experienced by students in the operational environment. Students could be asked to talk through the procedures for handling these types of malfunction in the aircraft they are studying. The availability of a cockpit mockup, such as a paper tiger, would allow students to actually work through the procedures.

Computer-based training (CBT) is becoming a popular tool for supporting information-based learning. One approach to designing CBT software is to use it to mimic the functioning of the individual aircraft systems. This approach could be taken an additional step by using failure-based scenarios as a means of testing what the student has learned. This type of evaluation approach is especially interesting in that it evaluates how effectively students can apply the information they have learned and not simply on memorization skills.

CRM issues are common in many incident reports. Tracing the breakdowns in good CRM procedure is useful as a way of helping students learn to work through the logic of a situation, including identifying points during the incident where alternative courses of action could have prevented the incident.

Qualification Flight Training

Qualification flight training has the objective of using flight training devices and simulators as tools for helping students learn to operate a new type of aircraft. Typically, the flight curriculum is built upon a core set of normal and non-normal maneuvers and procedure sets which are either likely to occur during a normal flight or are the more likely types of malfunctions found in that aircraft. The curriculum could be supplemented by including additional scenarios that might better prepare students for the more common types of problems they may face in the operational environment. For example, scenarios could be built around the types of problems experienced by pilots who are low time in type.

Scenarios could also be based upon types of incidents found to occur for a given maneuver. Replicating the conditions under which difficulties with a given maneuver may occur better prepares pilots by expanding their understanding of how they can get into trouble with that maneuver.

Continuing Qualification Flight Training

Continuing qualification flight training offers the carrier an opportunity to address problems that appear to be occurring on the line. Most carriers maintain a database of incidents and problems that have occurred for that carrier's fleet. It may be useful, however, to expand this view to include problems that have been experienced by other carriers. In addition, some carrier databases are organized in accordance with malfunction type, which makes searches for other types of issues difficult to perform. A variety of types of searches are appropriate for continuing qualification which expand beyond the specific training issues which are the focus of qualification training. Searches of incidents experienced by similar types of carriers may be useful to the small regional or commuter carrier whose own fleet may be small but wants to learn from the experiences of others. Searches of the types of incidents that occur for specific routes flown or expected to be flown by the carrier may also be useful.

CRM issues are especially appropriate as topics for continuing qualification. Some carriers select a CRM topic as the focus of their annual LOFT. A search of the ASRS database using CRM search terms can produce a set of incident reports that help to describe the conditions under which a breakdown in CRM occurred. These conditions can be replicated in a LOFT, enabling crews to learn how to avoid similar problems. Procedures for designing effective LOFTs using ASRS incident reports can be found in the ATA LOFT Design Focus Group's (1994) paper on LOFT scenario design.

PERFORMING AN EFFECTIVE SEARCH

Performing an effective search requires some understanding of the structure of the database and its records. The ASRS CD-ROM contains approximately 50,000 full-form incident records. To access only that set of reports relevant to the search requires an organized search process that utilizes the database structure of information fields to best advantage. A few simple procedures increase the likelihood of a successful and efficient search.

Conceptualizing the Search

The first step involves clearly defining the scope and objectives of the search. A poorly defined search can result in an unmanageable number of reports that are not relevant to the issue of interest. For example, a simple search of the ASRS CD-ROM using the search words *FMS* (Flight management system) and *FMC* (flight management computer) produced more than 800 reports. In many of these reports, the FMS or FMC had no causal involvement in the incident. Failure to use appropriate search terms, on the other hand, may produce an incomplete search that fails to access relevant reports.

- *Defining the scope of the search*. The simplest way to scope a search is to answer the question, Why is the information needed and what will it be used for? The scope of the search can be narrowed by accessing only those reports which reflect incidents that occurred at specific locations, during certain types of missions, or that involved conditions or factors relevant to the issue of interest. The more focused the search is on specific subject areas, the more likely the result will be reports that are relevant to the search topic.

- *Identifying search terms.* Relevant search terms can be identified by answering the question, How would a pilot or air traffic controller describe the problem or issue? Many of the fields support a very limited number of terms. For example, the field, "Incident Description," supports 30 terms. However, many searchers want to take advantage of the narrative field, which consists of the reporter's description of what took place. Because this field is free text, the searcher must anticipate the types of terms a reporter is likely to use. Many of the reporters are aviation professionals who employ terminology commonly used in flight operations. Use of aviation terminology increases the likelihood that retrieved reports will be relevant and useful.

  Example: Suppose the topic of the search is wake turbulence incidents.

  Terminology too broad: If the search uses only the word *wake*, the search results will include incidents of reporters "waking up," getting a "wake-up call from ATC," etc. Time will be wasted reading irrelevant reports.

  Terminology too narrow: If the search uses the technical term *wake vortex*, some relevant reports will be excluded because not all pilots or controllers use this term.

  Terminology appropriate: If the search uses the term *wake turbulence*, most relevant reports on the ASRS CD-ROM will be captured, since this is the term that most pilots and controllers would use to describe the problem.

Performing the Search

Once the goals and issues of the search have been carefully defined and search terms identified, selection of the set of fields to use in the search must be selected. The range of information types included in the database offer the searcher a great deal of flexibility.

- *Use the "All Text" field for most searches*. Full-form incident reports contain several different textual fields. These include a textual Synopsis by an ASRS analyst (SYN); the reporter's narrative (NAR); and a keywords field (KEY) with descriptive event identifiers supplied by ASRS analysts. All of these fields can be found in the "Textual Information" block on the CD-ROM search screen. One textual search option—the "All Text" Field—combines all of the text fields. Choosing the "All Text" option to enter search terminology means that the search will include the ASRS analysts' event synopses and keywords as well as the reporters' narratives.

- *Use the "Browse" (F2) function to find new textual terms that will help focus the search.* When a search is first completed, scan the report narratives using the "Browse" function to see if the report set is relevant to the search goals. Additional terminology may be found in the narratives that was not included in the first search. Adding these new search terms will increase the number of relevant reports found.

- *Use linking capabilities to select the best report set for each search.* The search tools provided by the ASRS CD-ROM include logical and proximity operators that combine report sets and subsets in different ways. These operators, which are explained in detail in the CD-ROM documentation, are used to combine the results of several exploratory searches into one final report set that will meet search goals.

- *Searches on very specific technical or equipment topics usually require report screening.* Searches related to specific aircraft automation or equipment features may require considerable screening of reports and fine-tuning of search terminology. For example, "mode control," a concept associated with flight deck automation, is difficult to search for in the ASRS database because many types of automated equipment may possess this feature. Be as specific and technically accurate as possible in using search terminology for these kinds of topics. In some cases, the terminology used for a given type of automation or equipment varies with the manufacturer. Using the specific terminology will narrow the search accordingly.

Types of Field Information and How They Can Be Used

Special fields have been included in ASRS incident records which can be strategically used to focus the search on relevant reports. An understanding of the value of these fields can strengthen many search strategies.

- *Searches of special fields are useful for full-form (narrative) reports.* Full-form database records contain much more fixed field information than abbreviated-form records, and they also contain reporters' narratives, which the abbreviated records do not. Use of special fields (such as the "Education Flag," described below) is recommended for full-form records, only.

- *Use the "Other Event Categorizations" search block.* This search block contains several search options that can yield valuable information: (1) the "FAA Air Traffic Incident" classifications; (2) the "Situation" field, which tells whether the event qualified as a recurring incident type; and (3) the "Education Flag" field, which tells whether an ASRS analyst considered the report to have unusual operational or descriptive merit.

- *Use the "Education Flag" option if a small number of especially informative reports is useful, or if recency of data is not important.* The ASRS database contains a relatively small number of reports that are considered to have special operational significance or to be unusually informative. These "EFLAG" reports cover many different incident types.

- *The "Incident Description" search block is also useful.* This search block contains the search options "What Anomalies Occurred" and "Known Consequences." "Anomalies" refers to unsafe

or illegal actions or conditions involving an aircraft that resulted from the incident. "Consequences" refers to the final outcomes of the incident, including injury to personnel, aircraft damage, FAA investigatory follow-up, FAA assigned or threatened penalties, and flight crew/ATC review of the incident.

Relating and Connecting Multiple Fields

Familiarity with the types of information provided by each record field supports more focused searches. Combining search terms used in the same or different fields can narrow the search results dramatically, reducing the number of irrelevant reports.

- *Many ASRS database fields allow multiple coding entries*. These are called "multiple" fields; examples are the Anomalies, Aircraft, and FAA Air Traffic Incident fields. To illustrate, a single incident may involve three anomalies—an altitude deviation, an air traffic conflict, and a violation of Federal Aviation Regulations (FARs). All three would be coded in the Anomalies field.

- *Use Logical and Proximity Operators to link terms within, or between, multiple fields.* Logical operators allow search terms to be linked using such operators as "and," "or," and "not." Proximity operators can be used to define the maximum number of words that can separate two search terms within a sentence of block of text. For example, when performing a search on "situation awareness," the "adjacent" operator would be used. Otherwise, reports which happen to include the words "situation" and "awareness" will be retrieved.

CONCLUSIONS

This brief description of the types of searches that can be performed using ASRS only hints at the many ways incident reports can be used to strengthen an AQP curriculum. With practice, a curriculum designer or flight instructor can learn to efficiently access useful reports that will support the objectives of a classroom lesson or a simulator session. Using real-world examples is an effective way of keeping students' attention and encouraging discussion. Pilots share these stories informally as a means of increasing their awareness of the many ways in which flight crews can get into trouble. Using the ASRS database is one means by which this time-honored method can be formally implemented in a flight training curriculum. Used properly, ASRS reports can expand pilots' aviation knowledge and hone their analytical skills.

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