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Report to the Chair, Subcommittee on Government Activities and Transportation, Committee on Government Operations, House of Representatives

August 1992

AVIATION SAFETY

Progress on FAA Safety Indicators Program Slow and Challenges Remain

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Information Management and
Technology Division

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August 31, 1992

The Honorable Barbara Boxer
Chair, Subcommittee on Government
Activities and Transportation
Committee on Government Operations
House of Representatives

Dear Madam Chair:

Aviation safety is without question the Federal Aviation Administration's (FAA) most important mission. Moreover, it is an area in which FAA has enjoyed considerable success: commercial air travel is regarded by many as the safest means of transportation in the United States today. However, improvements in how FAA measures and manages this important area are possible, and have long been recognized as needed by members of Congress, the National Transportation Safety Board (NTSB), and ourselves.

Through your work in promoting aviation safety, you have recognized that reliable measurements of safety are critical to FAA's ability to satisfy its mission. Because of your interest in this area, you requested that we review FAA's Safety Indicators Program. This program involves the development and monitoring of key indicators of aviation safety and an automated decision support system to analyze these indicators. Our objectives were to (1) determine the status and progress of the program and (2) identify barriers to its implementation. In April 1992 we testified before your Subcommittee on our preliminary observations on this program,[1] and made recommendations to which FAA has yet to officially respond. We recommended that the Administrator, FAA, develop a plan that provides for (1) effective user involvement, (2) requisite funding for meeting program milestones, and (3) source data integrity. This report updates and expands on our testimony. A detailed explanation of our objectives, scope, and methodology appears in appendix I.

[1] Aviation Safety: Slow Progress, Uncertain Future Threaten FAA Program to Measure Safety (GAO/T-IMTEC-92-12, Apr. 1, 1992).

Results in Brief

After spending 4 years and over $7 million on the Safety Indicators Program, FAA has made little progress on accomplishing its goal of developing a consistent set of safety measures and the supporting computer analysis capability for (1) quickly and vividly presenting the state of aviation safety and (2) supporting decisions on potential changes to safety activities. These measures, or indicators, are intended to direct the attention of top-level FAA management to emerging issues and potential problems, and allow management to more proactively manage the agency's safety mission.

Ineffective user involvement and unclear management commitment have contributed to the agency's inability to complete the program. In April 1992, FAA created a task force to accelerate this program. The task force's goal was to review the indicators under development and formulate a comprehensive aviation system indicators program and implementation plan. FAA released the task force's report in mid-July. Despite this action, completion of the program is still years away, and addressing problems with source data reliability poses a formidable challenge.

Background

FAA currently monitors aviation safety and compiles safety-related data. However, the information systems it uses to do so, by FAA's own admission, are severely limited. They are stand-alone systems that were not designed to share data or readily permit the sophisticated analysis necessary to effectively manage this important mission area. FAA's Safety Indicators Program is intended to improve this situation.

The Safety Indicators Program: What Is It?

The Safety Indicators Program has two basic components—development of the safety indicators themselves (i.e., categories of safety measurement for the aviation system), and development of a decision support system (i.e., computer analysis tool) with which to obtain information from numerous stand-alone databases for sophisticated analysis and presentation.

The Safety Indicators Program is being managed by FAA's Office of Safety Analysis, which falls organizationally under the Associate Administrator for Aviation Safety. This office includes two components working jointly to implement the Safety Indicators Program—the Safety Indicators Division and the National Aviation Safety Data Center (NASDC), within the National Aviation Safety Data Division. The indicators themselves are being developed by the Safety Indicators Division; the decision support system is being developed by NASDC.[2] The Office of Safety Analysis is currently undergoing a reorganization. Appendix II contains a current and proposed organization chart for this office.

The Office of Safety Analysis is distinctly separate from many of the potential users of the indicators. These users include the appropriate FAA operational offices (e.g., Air Traffic, Airway Facilities, Flight Standards), the FAA Administrator, and the Congress. Some data may also be available to the aviation industry and the general public, in a limited fashion still to be determined. Appendix III contains a chart showing the relationships among these FAA organizations.

Since 1988, when the program was initiated, FAA has spent almost $7.2 million on the development of safety indicators and the supporting computer analysis tool.

A Brief History of the Program

The genesis of the program can be traced to a 1987 Senate Appropriations Committee report that directed FAA to develop "a standardized set of safety indicators which can be used with confidence to measure the safety performance of FAA's air traffic operations on a consistent basis over time."[3] In January 1988 then-FAA Administrator T. Allan McArtor built on this direction and announced the establishment of the Safety Indicators Program. The program was to begin with development of air traffic indicators and be followed by flight operations indicators. According to the Administrator, the differences among the various databases FAA was using made it difficult to define and measure the overall safety of the nation's airspace. The Administrator called for a prototype system by the end of 1988.

[2]NASDC's goals are to extract data from existing safety-related data systems, enhance its quality and dependability, and improve the analytical methods used to integrate and analyze safety information.

[3]Senate Committee on Appropriations, Report on the Department of Transportation and Related Agencies, Fiscal Year 1988 Appropriations Bill, Report 100-198, p. 30, October 8, 1987.

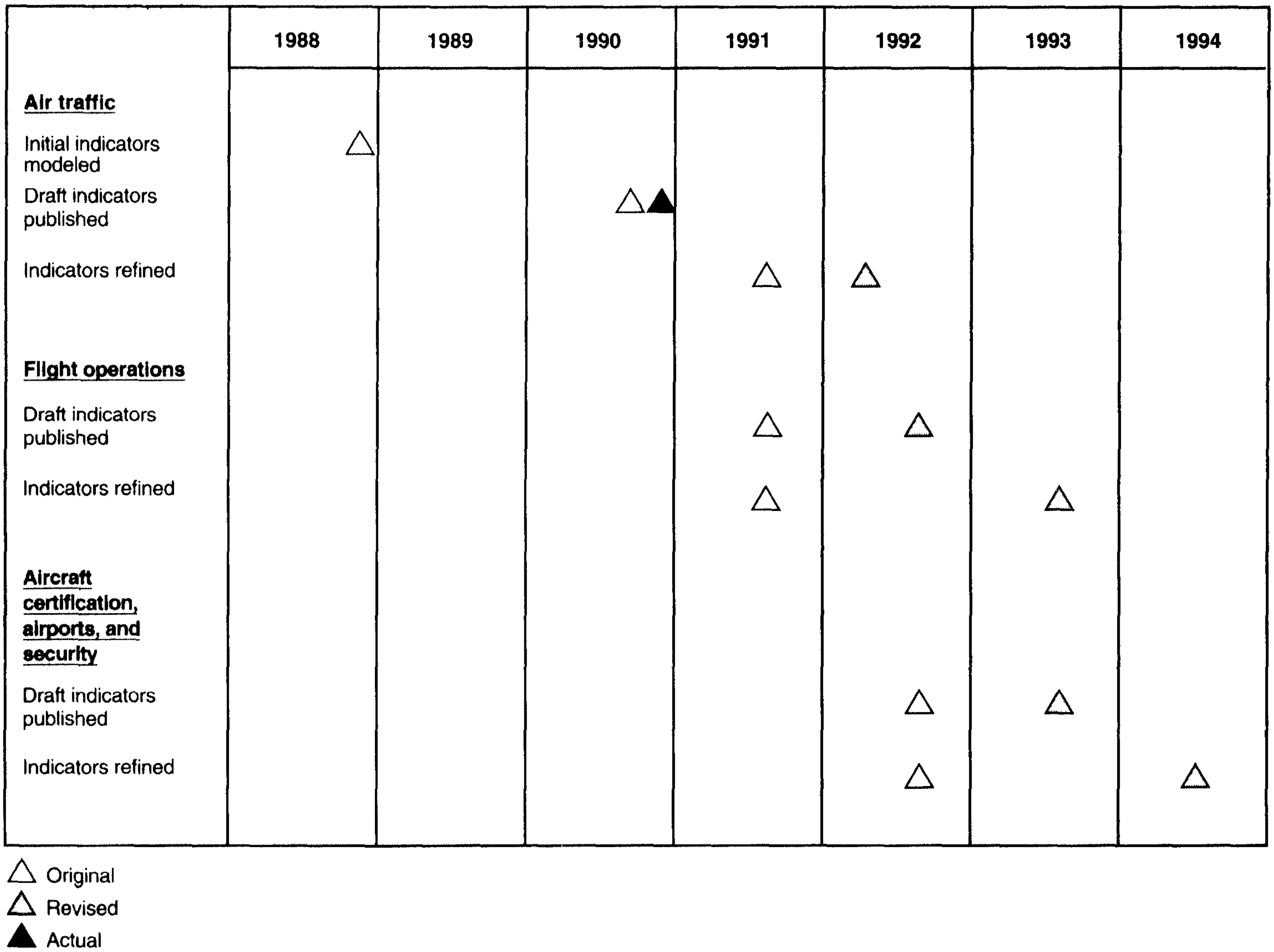
In 1989 FAA completed a concept definition document for the program, dividing the indicators into five categories—Air Traffic (includes Airway Facilities), Flight Operations, Aircraft Certification, Airports, and Security. In February 1990 FAA published a program plan that provided more specific milestones and extended the date for completing the final category to fiscal year 1992. FAA has spent the ensuing 2 years attempting to develop the indicators and the associated decision support system. In April 1992, the FAA Administrator redirected the program and created a task force to accelerate the identification and implementation of indicators. In July 1992 the Administrator approved a list of indicators and a plan for implementing them.

Progress in Developing Indicators Had Been Slow

Until April 1992, little had been accomplished; of the five categories of indicators, only Air Traffic had progressed before the development effort was redirected this past April, and even this progress was meager. Reasons for the delays include lack of effective user involvement and unclear management commitment.

FAA's first milestone for developing safety indicators, established by former Administrator McArtor, was to have prototype indicators by the end of 1988. Fourteen months following this target date, FAA developed an Aviation Safety Indicators Program Plan, which established five categories for the indicators and set milestones for each. In late 1991 these milestone dates were extended. Specifically, the Air Traffic indicators' completion milestone was extended from fiscal year 1991 to fiscal year 1992; the Flight Operations indicators' completion milestone went from fiscal year 1991 to fiscal year 1993; and the Aircraft Certification, Airports, and Security indicators' completion dates were extended from fiscal year 1992 to fiscal year 1994 (see fig. 1).

Figure 1: Indicator Milestones at Time of Program Redirection in April 1992



Before the program was redirected, FAA had made the most progress on the Air Traffic indicators. At that time, the Safety Indicators Division had published 48 draft indicators. It was close to reaching agreement on 4 of them with the Offices of Air Traffic and Airway Facilities; 9 had been dropped and 35 were under negotiation (see app. IV for detailed information on these draft indicators). However, the original completion milestone for these indicators was more than 8 months overdue at this time, and the draft indicators had been in circulation within FAA for about 16 months.

Reasons for Delays in Developing Indicators

Ineffective user involvement and unclear management commitment contributed to FAA's delays in developing the safety indicators. Specifically, the Safety Indicators Division, for the most part, developed the preliminary Air Traffic indicators without the benefit of continuous involvement by key users (i.e., managers in the Air Traffic and Airway Facilities organizations). According to the manager of the Safety Indicators Division, they began developing the indicators by questioning Air Traffic and Airway Facilities users about safety databases used and solicited ideas on how to measure safety. However, they did not involve the users in formulating the specific candidate indicators. They felt that developing candidates for the users to react to would facilitate a dialogue and expedite the process. After issuing these candidates, however, a wide difference of opinion as to what constitutes acceptable measures of air traffic safety resulted between those developing the indicators (Safety Indicators Division) and many of those who were targeted to use them (Air Traffic and Airway Facilities organizations). Approval of these indicators was therefore delayed. According to Air Traffic and Airway Facilities officials, their involvement in developing indicators was minimal; and as a result, they stated, many of the candidate indicators that the Safety Indicators Division created (see app. IV) bore no relation to actual safety measures. The Associate Administrator for Aviation Safety has acknowledged that the users perceived their participation in developing the indicators as inadequate.

Unclear top-level management commitment also contributed to the indicators' slow pace of development. To illustrate, top-level management did not attempt to facilitate negotiations despite the fact that after 16 months of discussions, no agreements had been reached on any of the 48 draft indicators. According to the Associate Administrator for Aviation Safety, clear top-level management backing of the program is essential for it to succeed. One gauge of top-level management backing or commitment to a program is a clear definition of the responsibilities and authority of those participating in that program. In the case of the Safety Indicators Program, it has operated for 3 years on the basis of a pending order that has never been signed. In light of the interdependence among the Safety Indicators Division as the program developer and the operational units as program users, a clear statement by top-level FAA management of the units' respective responsibilities and authority is important in fostering cooperation.

Development of Key Decision Support System Components Has Also Lagged

The critical link between FAA's raw safety-related data and meaningful safety indicators information will be a decision support system that is currently under development. To date FAA has developed a prototype system that has successfully extracted data from three databases. However, progress in developing other important aspects of the prototype has been hampered by the same factors that have caused slow progress on the indicators themselves—ineffective user involvement and lack of clear management commitment to the program.

The Decision Support System: a Brief Description

A well-designed decision support system is a very user-friendly, highly interactive, automated information system that fully integrates data from cross-cutting sources (i.e., data from all functional areas and all levels of an organization). These systems are designed to help decisionmakers analyze situations by asking "what if?" questions and receiving quick responses in an easy-to-understand format.

The decision support system for FAA's Safety Indicators Program is intended to (1) import data from FAA's diverse collection of existing safety-related databases; (2) validate the consistency and accuracy of these data; (3) integrate the data to form the various indicators of safety; (4) allow FAA analysts and managers to interact with the data, performing sophisticated correlations and asking the "what if?" questions (e.g., what might happen to the number of controller errors at Los Angeles International Airport if the number of aircraft arriving and departing increased by 10 percent?); and (5) format the results of this analysis in a wide variety of graphical and otherwise meaningful displays. (More detailed information on the system is contained in app. V.)

Some Progress Made in Developing Decision Support System, but Key Aspects Delayed

The Safety Indicators Program's decision support system has progressed well in some respects, while it has experienced delays in others. Unfortunately, the areas in which delays are occurring are critical to the success of the system, and problems being faced in these areas are formidable. Begun in 1990, the prototype decision support system was to be completed in 1993, with completion of the fully functional system scheduled for 1997.

To NASDC's credit, it has met several of its key interim milestones for the prototype system. For example, in 1990 it completed the prototype data dictionary, and in 1991 it standardized select data element names and developed a limited data importation capability. It can now retrieve and load data from three existing databases that it maintains into a temporary database management system that permits analysis. It has also begun extending its target database management system to provide the capability for automatic screening of imported data to enhance the data's consistency and accuracy. Other key interim milestones, however, have not yet been met. For example, NASDC has yet to acquire data from diverse sources outside of its own division. Although NASDC planned to be able to import the data residing in databases outside the three it maintains by September 1991,[4] development of this capability has yet to begin. This capability is critical to the success of the decision support system. NASDC estimates that selective extraction from as many as 70 aviation data sources will be required.

In addition, NASDC has yet to provide a human/machine interface that all potential users believe meets their needs, although the milestone for completing this activity was September 1991. The importance of this activity cannot be overstated. A critical component of a successful decision support system is an interface with which end-users can easily relate and interact.

NASDC has been developing the system's human/machine interface without the benefit of early and continuous participation by users outside the Office of Aviation Safety. Although it conducted two demonstrations of the prototype system's analytical capability, it only recently provided Air Traffic and Airway Facilities users with a feedback mechanism through which to comment on the system. Consequently, users have not yet accepted the prototype. For example, Air Traffic officials stated that it is not clear to them who the users will be, what the system's functions are, and what the utility of the system is. They further believe that their own systems provide all the information needed.

The Associate Administrator for Aviation Safety agreed that users have not been effectively involved in the development process and, therefore, did not understand the system's benefits. Because of this, she has taken steps to better involve users. For example, a needs assessment meeting was held

[4]The three databases contain incident data on near-midair collisions (reports from pilots or flight crew that a collision hazard exists between aircraft), pilot deviations (pilot actions that violate FAA regulations), and operational errors (air traffic control system-caused occurrences in which less-than-required separation occurs between aircraft or between an aircraft and the terrain or some other obstacle).

this past February to give anticipated users the opportunity to learn about and comment on the entire Safety Indicators Program.

In commenting on a draft of our report in July 1992, the Associate Administrator for Aviation Safety stated that FAA redefined who the immediate system users will be. The users for now are to consist only of Office of Aviation Safety staff. However, she added that the number of users could be expanded at a later date to include those originally envisioned (e.g., Air Traffic, Airway Facilities). We question this change. While restricting the near-term user community simplifies the task of user acceptance of the system in the immediate future, it also exacerbates the difficulties FAA was already facing in gaining system acceptance by users outside the Office of Aviation Safety. In our opinion, the likelihood that this group of users will accept a system at some point in the future, given that they have not been effectively involved in the system's development to date and given that they are now being excluded as near-term system users, is bleak. Moreover, this group of users represents the originators of the data upon which the decision support system will rely. By excluding them from the system's development, the likelihood that they will cooperate in improving the quality of this source data is greatly diminished.

Unclear management commitment to the system has also contributed to delays in its development. One measure of commitment is funding. According to the NASDC manager, system development funding for the last quarter of fiscal year 1992 remained uncertain up until the last moment. He also stated that such funding uncertainties have been common and have made it difficult to keep the system on schedule. For example, NASDC's plan to begin importing data from databases external to its own by September 1991 has yet to begin because of funding shortages. Such delays increase the time lag between when the indicators will be established and when the decision support system has the capability to fully analyze them.

NASDC has been trying to get development funds for the system from an alternative source. In the past, the program has had to compete for funds with other activities under FAA's Office of Aviation Safety. An alternative funding mechanism is FAA's Capital Investment Plan, under which funding is earmarked for specific projects, making increased and continued support more likely. The system was considered for inclusion in the fiscal year 1993 Capital Investment Plan, but was ultimately dropped in favor of other priorities. According to the NASDC manager, the project has been approved for inclusion in the fiscal year 1994 Capital Investment Plan;

however, according to this plan, a full-scale decision support system to analyze indicators will not be available until fiscal year 1997.

Risk Identification Tool Supports Our Concerns About Decision Support System

To augment our analysis of the decision support system's development risks, we applied the Risk Identification Tool for Expert Systems (RITES). This tool, developed by the Computer Science and Information Systems Department at The American University, was pilot-tested in 1990 and presented at the 1991 International Conference on Developing and Managing Expert System Programs, sponsored by the Institute of Electrical and Electronics Engineers and the Association for Computing Machinery. It is designed to quickly identify the risks facing an organization in developing systems with expert or knowledge-based applications. In applying RITES to FAA's decision support system development, we conferred with the NASDC program manager, who agreed that RITES was an appropriate tool to use in assessing the system's risks. (See app. I for more details on this tool).

The tool characterized the risks facing FAA in developing the decision support system as being moderate to high. While this assessment does not translate into a "do not proceed" conclusion, it does point out that successfully completing the decision support system on time and within budget will require NASDC and FAA to effectively manage the same risk areas that our analysis surfaced. In particular, organizational concerns about the system must be addressed through more effective user involvement, the uncertainties and imprecision inherent in the aviation safety definition and measurement areas need to be examined in defining the indicators, and management commitment to the system must be demonstrated through adequate funding.

Recent FAA Changes to the Program

As noted earlier, the Administrator redirected the program in April 1992. Specifically, he created a task force of senior-level executives from FAA's program offices to accelerate the identification and implementation of indicators. The task force's goal was to review information on the four categories of indicators currently being used or developed—Air Traffic, Flight Operations, Aircraft Certification, and Airports—and agree on a set of indicators and a plan for implementating them within 30 days.[5]

[5]According to its chairman, the task force did not develop security indicators because the Office of Security was already developing these indicators separately.

In its July 1992 report, the task force established a list of 39 indicators for the entire aviation system and its environment, designating 27 as system indicators, or measures of overall aviation system performance, and 12 as environmental indicators, or measures of potential future demands on the aviation system. (See app. V.) Because FAA did not release these indicators to us until after we had completed our review, we did not evaluate them. However, it is important to note that these indicators are not as detailed as those FAA had originally tried to define. For example, the Air Traffic category, which previously had 39 indicators, now contains 10. In particular, the original Air Traffic indicators relating to staffing—including the percentage of full-performance-level controllers—has been dropped. The remaining three categories (Flight Operations, Aircraft Certification, and Airports) now encompass a total of five indicators.

The task force prescribed a two-part part plan for implementating the indicators. In the short term, FAA will refine the indicators, present them to industry and top FAA management, and implement them—using fiscal year 1992 data—by November 1992. In the long term, the agency will reconvene the task force on an annual and as-needed basis to refine the indicators.

Unreliability of FAA Databases Remains a Formidable Hurdle

A significant challenge facing FAA in its attempts to implement the Safety Indicators Program is the unreliability of many of its safety-related databases. Many of these databases are inaccurate, inconsistent, and often incompatible. For years we and others have warned about the problems with the quality of these databases (see app. VII for a description of these problems and the Related GAO Products listing at the end of this report for our past reports on this subject). The Associate Administrator for Aviation Safety has also acknowledged the seriousness of this issue. Unfortunately, the situation does not appear to be improving. As recently as last year, we reported that FAA's database supporting its inspection program was incomplete and inaccurate.[6]

As part of our review of the Safety Indicators Program, we performed a limited assessment of the reliability of one of FAA's databases that could provide source data to the program—FAA's Enforcement Information

[6] Aviation Safety: Problems Persist in FAA's Inspection Program (GAO/RCED-92-14, Nov. 20, 1991).

System (EIS).[7] Specifically, we asked FAA Western Pacific Region personnel to select 100 closed cases from an annual universe of such cases that averages about 550. We also asked that selected cases include at least five from each of FAA's 14 Flight Standards District Offices and 2 Certificate Management Offices. We then compared the data contained in the system with the source documentation (i.e., legal case files). Two-thirds—66 percent—of the 100 cases on the system contained some type of erroneous data; FAA's permitted error rate is 10 percent. More important, about one-third—35 percent—of the cases contained errors in data fields that FAA characterizes as critical; the permitted error rate is 5 percent.[8] For example, six airman certificate numbers were erroneous and thus could preclude FAA from accurately determining the violation history of any one of these offenders.

An FAA official responsible for the program acknowledged that problems have been associated with the EIS system in the past, but informed us of recent action to improve the accuracy of the data, and noted that this fact might not be reflected in our review of closed cases. However, the official could not provide any evidence of improved data accuracy.

Correcting the longstanding problems with the quality of FAA's safety-related databases is essential to the success of the Safety Indicators Program. However, it is also an area in which near-term corrective action does not appear likely. Specifically, while the decision support system is to provide the capability to fully screen all the data it imports for errors, reporting on the indicators between now and 1997 (when the decision support system is to be completed and all source data to be automatically screened) will be based mostly on limited manual screening. Consequently, the full extent of source data errors is likely to go undetected between now and 1997.

Moreover, merely screening the data, even if done automatically, does not guarantee that it will be corrected at the source. Doing this requires an FAA-wide plan for cleaning up its numerous databases. According to the head of the Information Management Architecture and Data Management

[7]The purpose of this system is to provide complete automation support for FAA's violation/enforcement data-gathering process. According to FAA, the system allows previous violations to be identified more easily and accurately, enabling the agency to carry out responsibilities quickly and efficiently.

[8]FAA defines a critical error as erroneous data in any one of the following data fields: name, date of birth, certificate type and number, regulations, action/sanction, investigative office/regional office dates, final action screen completion, and case status.

Division within FAA's Office of Information Management and Technology, FAA hopes to have a program plan by January 1993 for the development of the guidelines, tools, and repository methods that the respective database administrators can use to improve the quality of their databases. However, this plan will stop short of, for example, identifying specific goals and milestones for correcting individual databases. This official stated that such a plan is necessary to effect real improvements in the quality of FAA databases, and that FAA plans to develop such a plan but has not set a time frame. He also stated that achieving these goals would be a long-term effort.

Conclusions

Because the impact of FAA's redirection of the program is unclear at this early stage, and because FAA has yet to respond to the recommendations we made in our April 1, 1992, testimony on the program, we are not making any additional recommendations at this time. However, we believe that the program's future depends on more than FAA's recent program actions. It also depends on (1) FAA's effectively addressing the issues of source data reliability, and user involvement in and management commitment to the decision support system; and (2) FAA's continued review and refinement of the indicators to ensure that they satisfy the program's original goal of measuring the safety of our nation's aviation system.

Our review was performed from June 1991 through July 1992, in accordance with generally accepted government auditing standards. FAA's Associate Administrator for Aviation Safety, as well as representatives from Air Traffic and NASDC, provided oral comments on a draft of this report. These officials generally agreed with the facts as presented. We have incorporated their views as appropriate.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will provide copies of the report to the Secretary of Transportation; the Administrator, FAA; and to other interested parties. Copies will also be made available to others upon request. Please contact me at (202) 512-6416 if you have any questions concerning this report. Major contributors to this report are listed in appendix VIII.

Sincerely yours,

Michael Gryszkowiec

for JayEtta Z. Hecker
Director, Resources, Community and
Economic Development Information Systems

Contents

Abbreviations

EIS	Enforcement Information System
FAA	Federal Aviation Administration
GAO	General Accounting Office
IMTEC	Information Management and Technology Division
NASDC	National Aviation Safety Data Center
NTSB	National Transportation Safety Board
RCED	Resources, Community, and Economic Development Division
RITES	Risk Identification Tool for Expert Systems

Objectives, Scope, and Methodology

In response to a request from the Chair, Subcommittee on Government Activities and Transportation, House Committee on Government Operations, we reviewed FAA's Safety Indicators Program. As agreed with the Chair's office, our objectives were to (1) determine the status and progress of the program, and (2) identify barriers to the program's implementation.

To determine the status and progress of the program, we reviewed program planning and management documentation and traced changes in key milestones for development of both the indicators and the decision support system. We also interviewed program officials on the progress and current status of the program, and reviewed relevant program management and budget documents that discussed the program's history and current status. We then compared the program's status against original and revised milestones and identified any differences.

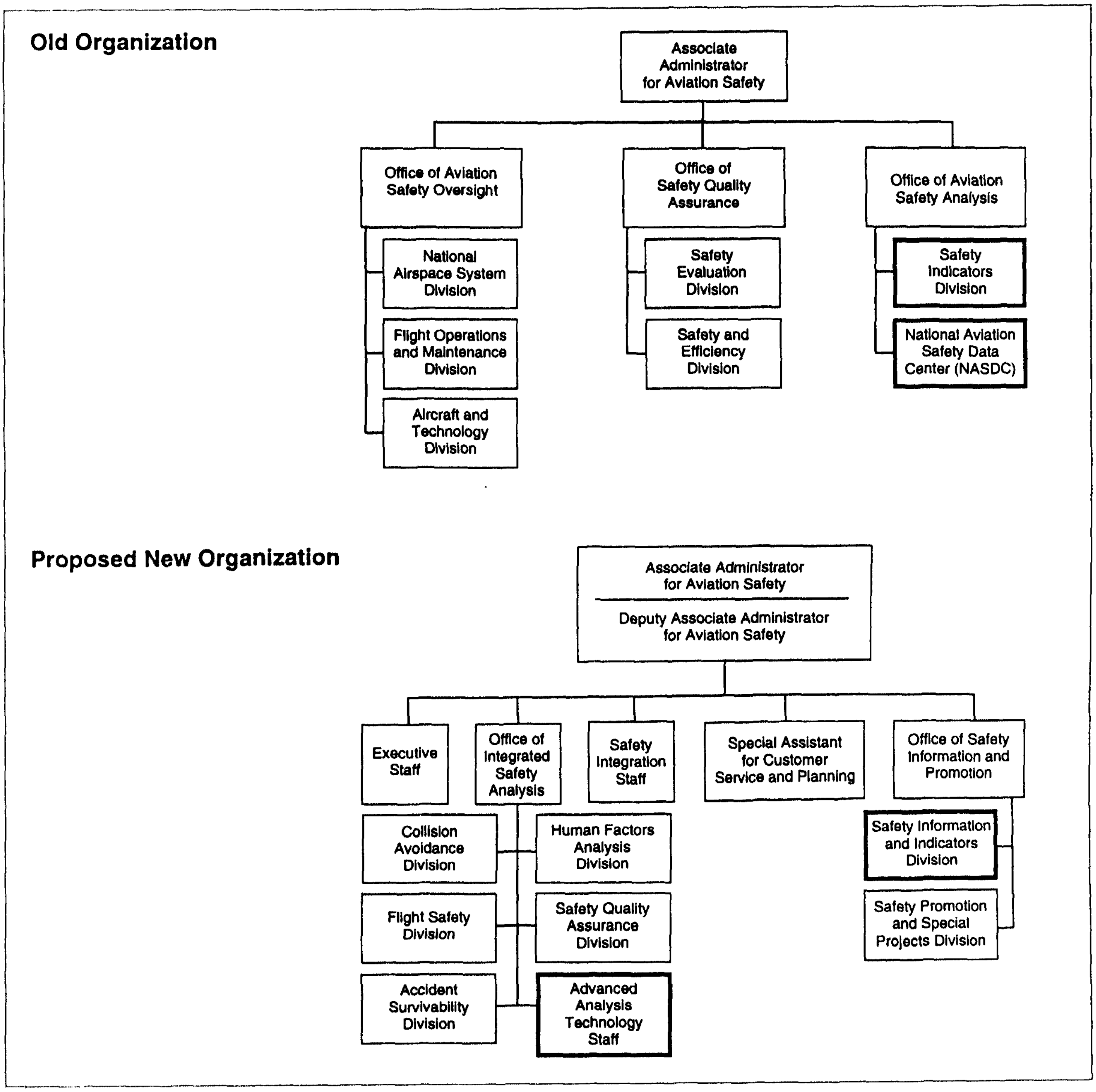
To identify barriers to the timely development of indicators, we interviewed program officials and potential users as to reasons for any delays in the program and solicited documentation to corroborate reasons cited. We also defined the process being followed to develop the indicators, and analyzed it for any potential shortcomings. Because FAA did not release its latest set of indicators to us until after we completed our review, we did not evaluate these indicators. However, we did include the indicators as provided. (See app. V).

To identify risks facing the decision support system's development, we reviewed system development documentation and interviewed program officials to determine the extent to which commercial, off-the-shelf software was being used and whether requisite system engineering practices were being followed. We also interviewed potential system users about their involvement in developing the system, and their reaction to the prototype system. Additionally, we interviewed program officials to determine the extent to which the system would rely on existing FAA databases to generate and analyze safety indicators, reviewed past GAO and Department of Transportation Inspector General work on the reliability of these existing databases, and examined 100 closed cases residing on one of these databases—the Enforcement Information System—to determine the extent to which errors were present. The 100 cases were selected by FAA Western Pacific Region personnel from a universe that annually averages about 550. The selected cases included at least five from each of FAA's 14 Flight Standards District Offices and 2 Certificate Management offices. We compared the case data from the Enforcement Information System with the data in the legal case files to identify discrepancies.

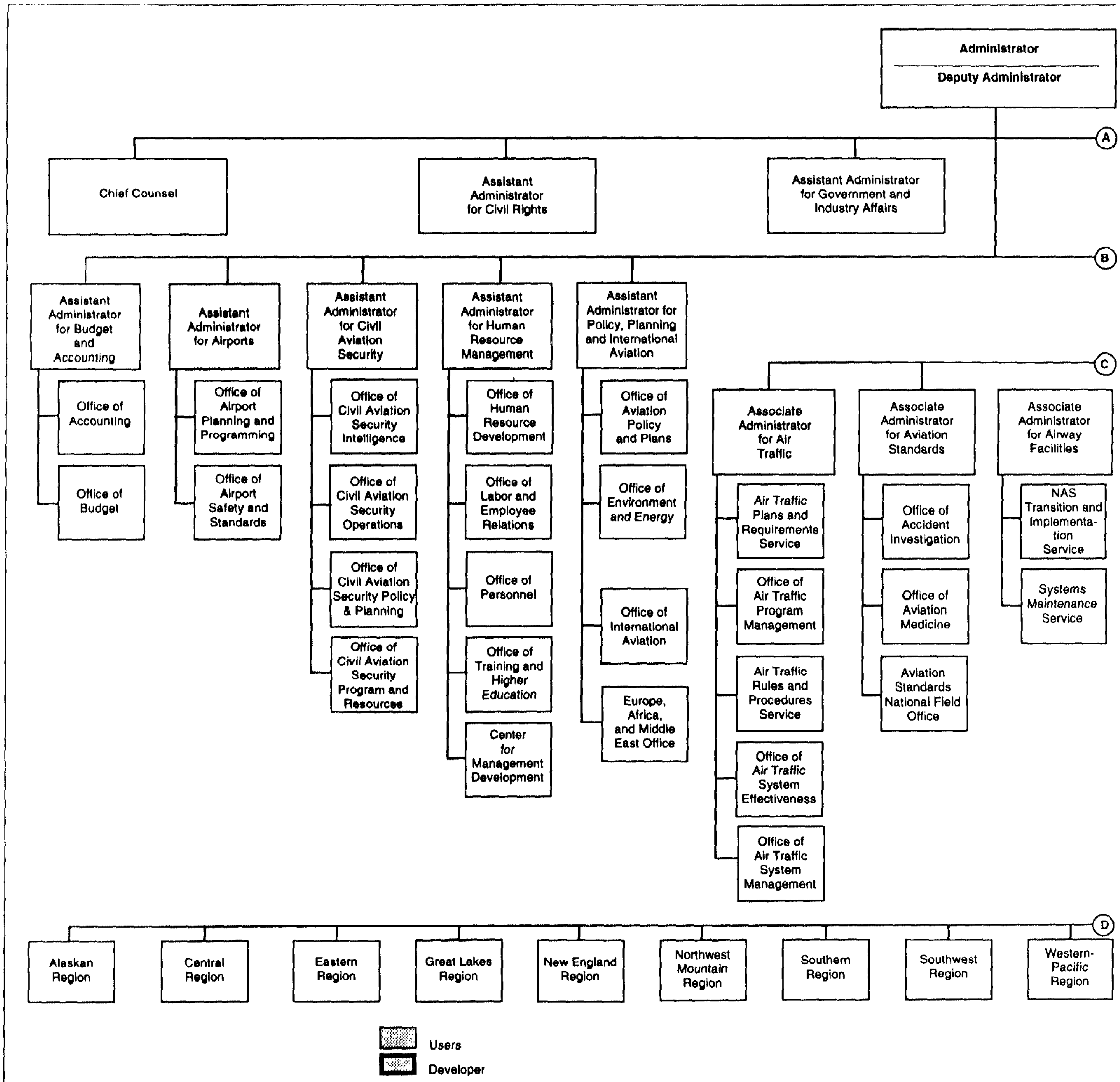
To augment these steps directed at identifying system risks, we also used a structured interview tool called the Risk Identification Tool for Expert Systems. This tool was developed by the Computer Science and Information Systems Department of The American University. It was pilot-tested in 1990 on 14 systems and was presented at the 1991 International Conference on Developing and Managing Expert Systems Programs, sponsored by the Institute of Electrical and Electronics Engineers and the Association for Computer Machinery. This tool poses a series of questions grouped into three categories that probe the system's inherent risks. The three categories are organizational impact, problem understanding/knowledge (precise versus esoteric), and personnel and resource capabilities. We applied the tool in collaboration with NASDC managers and technicians responsible for developing the system.

We performed our work at FAA headquarters, Washington, D.C.; FAA's Western Pacific Region, Hawthorne, California; FAA's Mike Monroney Aeronautical Center, Oklahoma City, Oklahoma; and the National Transportation Safety Board, Southwest Region, Hawthorne, California.

Office of Aviation Safety Organizations



Federal Aviation Administration Organization



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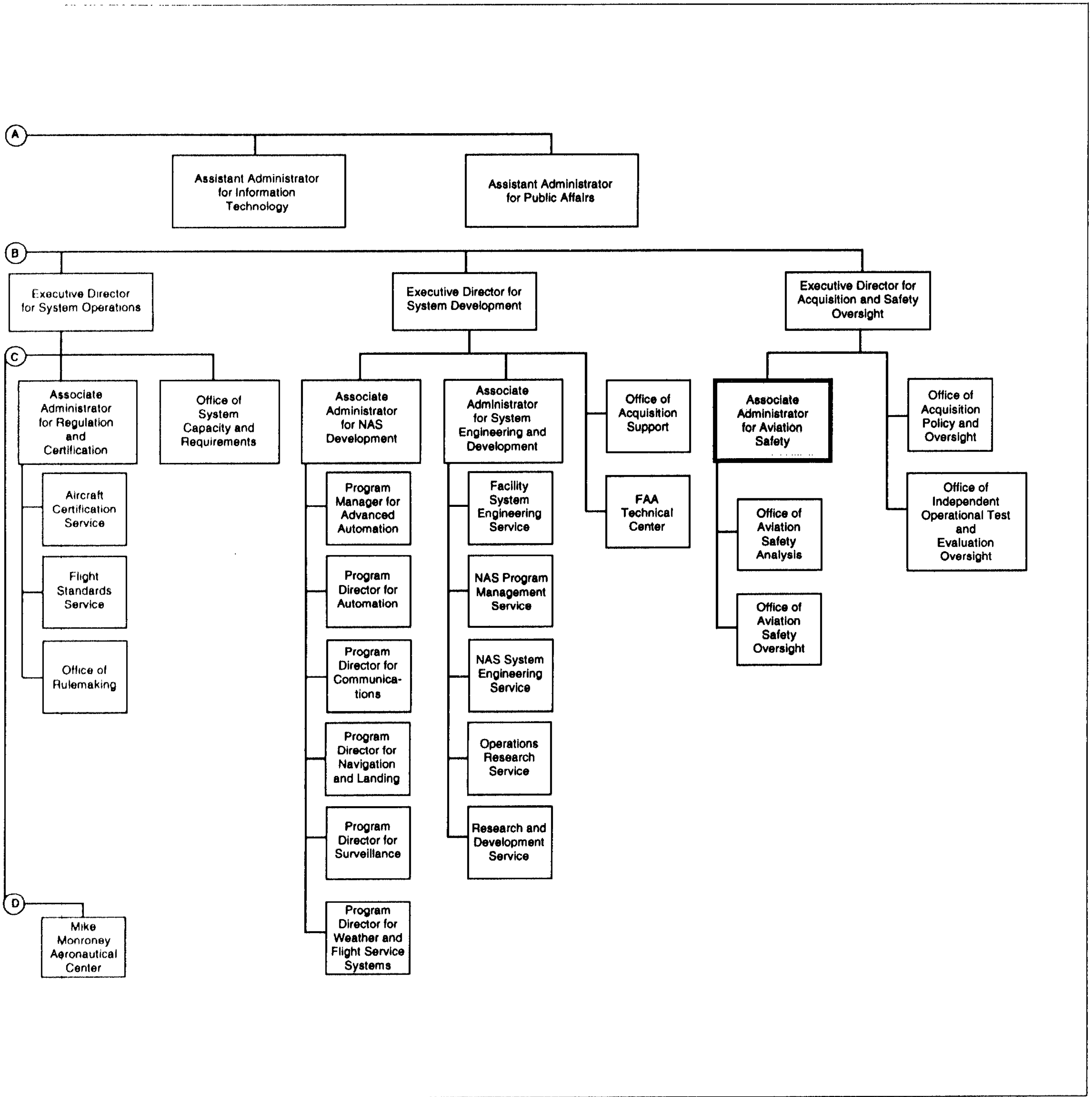
A
Assistant Administrator for Information Technology
Assistant Administrator for Public Affairs
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Executive Director for System Operations
Executive Director for System Development
Executive Director for Acquisition and Safety Oversight
C
Associate Administrator for Regulation and Certification
Aircraft Certification Service
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Office of Aviation Safety Analysis
Office of Aviation Safety Oversight
Office of Acquisition Policy and Oversight
Office of Independent Operational Test and Evaluation Oversight
D
Mike Monroney Aeronautical Center

Forty-eight Proposed Air Traffic and Airway Facilities Indicators at Time of Program Redirecton in April 1992

Indicators Near Agreement

1. Operational error rate: indicator is used to compute and compare the rate of air traffic control system-caused occurrences in which less than required separation occurs between aircraft or between an aircraft and the terrain or some other obstacle.

2. Operational deviation rate: indicator is used to compute the rate of occurrences where required separation is maintained but the controller did not comply with prescribed operating procedures and/or allowed an aircraft to enter another controller's airspace without proper coordination.

3. Near-midair collision rate: indicator displays the number of near-midair collisions per 100,000 operations.

4. Flight service station unavailability: indicator presents a measure of how often weather reports and other flight-related services are not available to general aviation pilots.

Indicators Under Negotiation

1. Aviation safety reporting system incidents: indicator displays actual counts of situations observed by pilots, controllers, passengers, and mechanics and reported to the National Aeronautics and Space Administration.

2. Number of problem ratings given to "critical items" per full-facility evaluation: indicator presents the average number of problem ratings given to critical items (most critical to safety) in full-facility evaluations.

3. Number of problem ratings given to "critical items" per in-flight/preflight evaluation: indicator presents the average number of problem ratings given to critical items for in-flight/preflight evaluations.

4. Percentage of facilities not receiving required number of full-facility evaluations: indicator shows the percentage of air traffic control facilities that did not receive at least one full-facility evaluation in the previous 2 years.

5. Percentage of facilities not receiving required number of in-flight/preflight evaluations: indicator shows the percentage of air traffic control facilities that did not receive at least two in-flight/preflight evaluations during the previous year.

6. Staffing shortfall: indicator presents the percentage of required full-time permanent controller positions that are not filled.

7. Non-full-performance-level controller percentage: indicator presents the percentage of full-time permanent controllers who are not full-performance-level controllers.

8. Controller overtime: indicator presents the average amount of overtime worked above a predetermined threshold by full-time permanent controllers per (2-week) pay period.

9. Controller attrition rate: indicator presents the rate at which full-time permanent controllers are leaving the air traffic control work force.

10. Work force eligible for retirement: indicator presents the percentage of the controller work force eligible for retirement.

11. Academy grades of developmental controllers: indicator is based on the average of the final grades received by each class of developmental controllers to graduate from the FAA Academy.

12. Controller work load: indicator calculates the total air traffic operations and normalizes the result by the number of controllers employed.

13. Air traffic delay performance: indicator displays the rate of delays per 100,000 air traffic operations.

14. Projected operations: indicator displays the growth rate in air traffic operations.

15. Unscheduled interruptions per facility: indicator reflects the number of instances key facility types or services were not available to the National Airspace System.

16. Mean time to restore key facility types: indicator reflects the typical time required to bring a facility back on-line to the National Airspace System.

17. Extreme interruptions: indicator measures the number of instances in which key facility types are restored to operating status after an amount of time that FAA determines to be excessive has elapsed.

18. Related unscheduled interruptions: indicator compares the number of unscheduled events linked by "related" cause codes with the number of key facility types.

19. Actual time versus scheduled restoration time: indicator compares the actual time required to complete scheduled maintenance and certification activities with the time projected for completing these activities.

20. Percentage of commissioned facilities experiencing certification problems: indicator is the percentage of facilities that required some degree of corrective action before routing certification could be made.

21. Mean time to perform corrective actions: indicator provides a mean or average time required to perform corrective actions to facilities that were not immediately ready for routing certification.

22. Percentage of commissioned facilities exceeding the maximum certification interval: indicator reflects the degree to which facilities exceed the maximum certification interval.

23. Percentage of facilities not flight-checked: indicator provides the percentage of relevant facilities not flight-checked out of the entire aviation safety-related facility population.

24. Percentage of flight-checked facilities out-of-tolerance: indicator provides the percentage of flight-checked facilities that are measured as being out of standard tolerance limits.

25. Technical evaluation accomplishment: indicator measures the technical inspection program's ability to meet inspection goals set by the Airway Facilities Goals and Objectives Program.

26. Quantity of key performance parameter discrepancies: indicator measures the number of key performance parameter discrepancies identified by technical inspectors during a given reporting period.

27. Staffing levels: indicator compares the number of technical positions that are not filled to the required number of technical positions.

28. Skill level of technicians: indicator compares the number of technicians who are not qualified to certify equipment systems or subsystems to the total technician work force.

29. Technician overtime: indicator measures the amount of overtime worked by airway facilities technicians within a pay period.

30. Technician attrition rate: indicator presents the rate at which technical employees leave the airway facilities work force.

31. Work force eligible for retirement: indicator identifies the percentage of airway facilities employees eligible for retirement.

32. Staff training: indicator compares the amount of training received by the airway facilities technical staff to the amount of recommended training.

33. Staff development: indicator measures the average amount of time required for new employees to reach the journeyperson technical level.

34. Number of key facilities commissioned: indicator measures the number of new key facilities that have been commissioned.

35. Flight service station service utilization: indicator measures the utilization of flight service station services.

Indicators Dropped

1. Air traffic-contributed accident rate: indicator displays the air traffic-contributed accident rate per 100,000 operations.

2. Mean time to clear action items: indicator provides a mean or average time required to clear or correct action items assigned to facilities by technical inspectors.

3. Managerial evaluation accomplishment: indicator measures the management evaluation program's ability to meet facility management inspection goals specified under the Airway Facilities Goals and Objectives Program.

4. Number of action items: indicator is the number of action items assigned as a result of management evaluations during a given reporting period.

5. Mean time to clear action items: indicator provides a mean or average time required to clear action items assigned to facilities during regional management evaluations.

6. Compliance with airway facilities goals and objectives: indicator measures the accomplishment of formal goals and objectives by regional offices.

7. Funding allocation for operations: indicator identifies the amount of funds annually budgeted for maintenance activities by the airway facilities divisions of the regional offices.

8. Age of key facilities: indicator identifies the age of key airway facilities.

9. Delays in installing new key equipment: indicator measures the number of postponed installations of new key equipment.

Aviation System and Environmental Indicators (July 1992)

System Indicators

1. Large air carrier accident rates: compares the number of accidents involving large air carriers to the number of departures and the number of flight hours for those carriers. This indicator is expressed as rates per 100,000 departures and 100,000 flight hours and is to be reported quarterly.

2. Commuter air carrier accident rates: compares the number of accidents involving commuter air carriers to the number of departures and the number of flight hours for those carriers. This indicator is expressed as rates per 100,000 departures and per 100,000 flight hours and is to be reported quarterly.

3. Air taxi accident rate: compares the number of accidents involving air taxis to the number of flight hours for those carriers. This indicator is expressed as a rate per 100,000 flight hours and is to be reported quarterly.

4. General aviation accident rate: compares the number of accidents involving general aviation operators to the number of flight hours for those operators. This indicator is expressed as a rate per 100,000 flight hours and is to be reported quarterly.

5. Rotorcraft accident rate: compares the number of accidents involving all rotorcraft to the number of flight hours for those operators. This indicator is expressed as a rate per 100,000 flight hours and is to be reported quarterly.

6. Midair collision rate: compares the number of midair collisions involving all operators to the number of flight hours for all operators. Since departure data are not available, this indicator is expressed as a rate per 100,000 flight hours and is to be reported quarterly.

7. Large air carrier aircraft incident rates: compares the number of aircraft incidents involving large air carriers to the number of departures and flight hours for those carriers. This indicator is expressed as a rate per 100,000 departures and per 100,000 flight hours and is to be reported quarterly.

8. Commuter air carrier aircraft incident rates: compares the number of aircraft incidents involving commuter air carriers to the number of departures and the number of flight hours for those carriers. This indicator is expressed as rates per 100,000 departures and per 100,000 flight hours and is to be reported quarterly.

9. Air taxi aircraft incident rate: compares the number of aircraft incidents involving air taxis to the number of flight hours for those carriers. This indicator is expressed as a rate per 100,000 flight hours and is to be reported quarterly.

10. General aviation aircraft incident rate: compares the number of aircraft incidents involving general aviation operators to the number of flight hours for those operators. This indicator is expressed as a rate per 100,000 flight hour and is to be reported quarterly.

11. Rotorcraft aircraft incident rate: compares the number of aircraft incidents involving rotocraft to the number of flight hours for those operators. Since departure data are not available, this indicator is expressed as a rate per 100,000 flight hours and is to be reported quarterly.

12. Near-midair collisions: presents the total number of system near-midair collisions.

13. Air carrier near-midair collision rate: compares the number of near-midair collisions involving all air carriers to the number of air carrier flight hours. This indicator is expressed as a rate per 100,000 flight hours and is to be reported quarterly.

14. Pilot deviation rate: compares the number of pilot deviations to total system flight hours. A pilot deviation is defined as the actions of a pilot that result in a violation of aviation regulations.

15. Operational error rate: computed by dividing the number of operational errors by total number of operations.

16. Vehicle/pedestrian deviation: presents the number of entries or movements on an airport movement area by a vehicle or pedestrian that has not been authorized by air traffic control.

17. Runway incursion rate: compares the number of runway incursions that occur at airports to the activity at airports. This indicator is expressed as a rate and will be reported quarterly.

18. Airport certification indicator rate: measures the number of deficiencies found through FAA inspections per the number of airports inspected.

19. Facility/service reliability: provides an aggregate estimate of the probability that a typical major facility or service will not fail during the mission time (24-hour period).

20. Facility/service operational availability: provides an aggregate estimate of the percentage of time a typical major facility or service is available to users of the National Airspace System.

21. Delay rate: measures the rate of delays per 100,000 operations at an air traffic facility.

22. Delay rate due to volume: measures the rate of delays due to traffic volume per 100,000 operations at an air traffic facility.

23. Aircraft certification system evaluation program surveillance: shows the percentage of scheduled evaluations that have actually been accomplished.

24. National program guidelines surveillance: this indicator records the number of required, planned, and special inspections accomplished during a fiscal year.

25. National program guidelines-required surveillance: compares the number of required inspections accomplished with the number of inspections required.

26. Airworthiness indicator report (aging aircraft): to be determined.

27. Stage 3 aircraft ratio: measures the aircraft operator's progress in meeting a 100-percent stage 3 noise level aircraft fleet by the year 2000.

Environmental Indicators

1. Forecast of quarterly or annual growth rate in real gross national product.

2. Forecast of annual enplanements and growth rate in annual enplanements.

3. Total air traffic facility activity.

4. Forecast of annual instrument flight rules aircraft handled at air traffic en route centers and the annual growth rate in these aircraft.

5. Forecast of general aviation hours flown and the growth rate in these hours.

6. Number of certificated airports.

7. Number of certificated airmen.

8. Number of certificated holders.

9. Number of registered aircraft.

10 Aircraft hours flown.

11. Number of production approval holders.

12. Operating profit or loss for all major, national, and large regional carriers.

Description of Decision Support System

Decision support systems' basic features include (1) being fully integrated and coordinated across all organizational lines and levels; (2) offering results of analysis on a while-you-wait basis, thereby supporting managers in making short-term, immediate decisions; (3) performing "what if?" analyses (i.e., determining the outcome of various business scenarios); and (4) being very user-friendly, because they are intended for use by managers, not computer technicians. To provide these features, decision support systems rely on sophisticated database management systems, rich graphical user interfaces, and advanced modeling and forecasting tools.

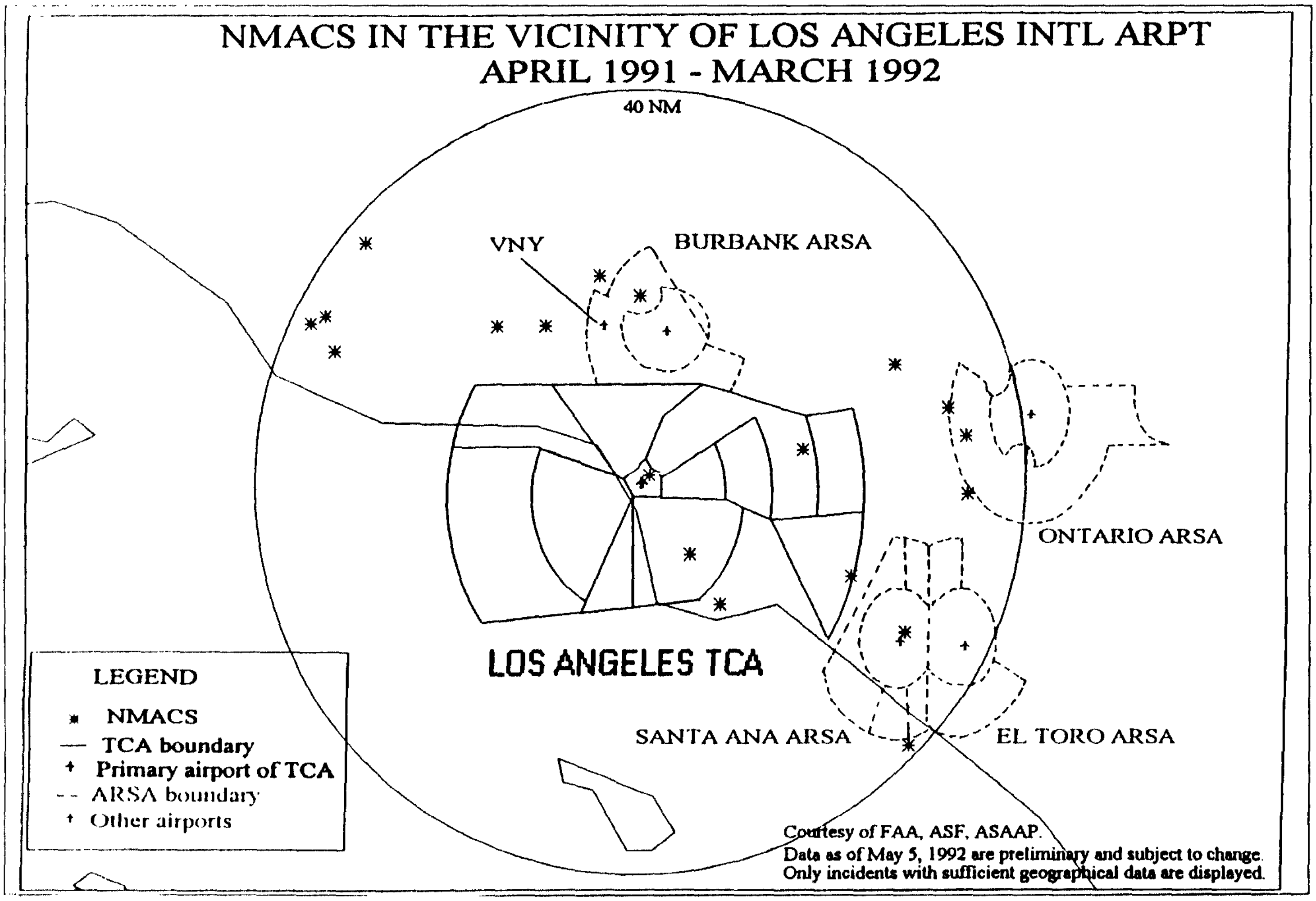
The decision support system NASDC is developing for the Safety Indicators Program is intended to possess each of these characteristics, and more. Specifically, the system is to be able to extract selected data from as many as 70 existing safety-related databases throughout FAA, validate the data, and store the data in a relational database management system called INGRES. This database management system resides on a National Highway Traffic Safety Administration minicomputer; FAA has a timesharing agreement with the National Highway Traffic Safety Administration for using the system.

Currently, the data validation requires extensive human interaction, checking data screens for fundamental errors. However, NASDC plans to use an artificial intelligence feature that INGRES offers to build a rule-based data quality assurance capability into the system. More specifically, NASDC will build a data encyclopedia within the system to standardize semantic and syntactical differences among the many FAA databases. For instance, "oil leak" may be defined differently by each database queried. The data encyclopedia will give one definition for the database queried and provide the alternative terms used in the other databases. When multiple databases are being queried, the data encyclopedia will automatically alter the query key word for each database. This is a particularly important capability due to the vast semantic and syntactical disparities among the different databases.

Once the data have been imported into the system and the quality has been validated, the system will allow sophisticated analyses and correlations of the data and display the results in various forms. An off-the-shelf software package will serve as the users' graphical interface to the system. Managers will be able to "drill down" a given data set to include only select data. First, they can plot on a map the number of runway incursions in California, for example, then drill down to show only Southern California, then drill down even further to show only the runway incursions at Los

Angeles International Airport. An example of a graphical display showing near-midair collisions over a 1-year period at Los Angeles International Airport is provided in figure VI.1. Future presentations of such data are expected to include three-dimensional modeling against topography and designated airport approach and departure routes.

Figure VI.1: Example of Decision Support System Display



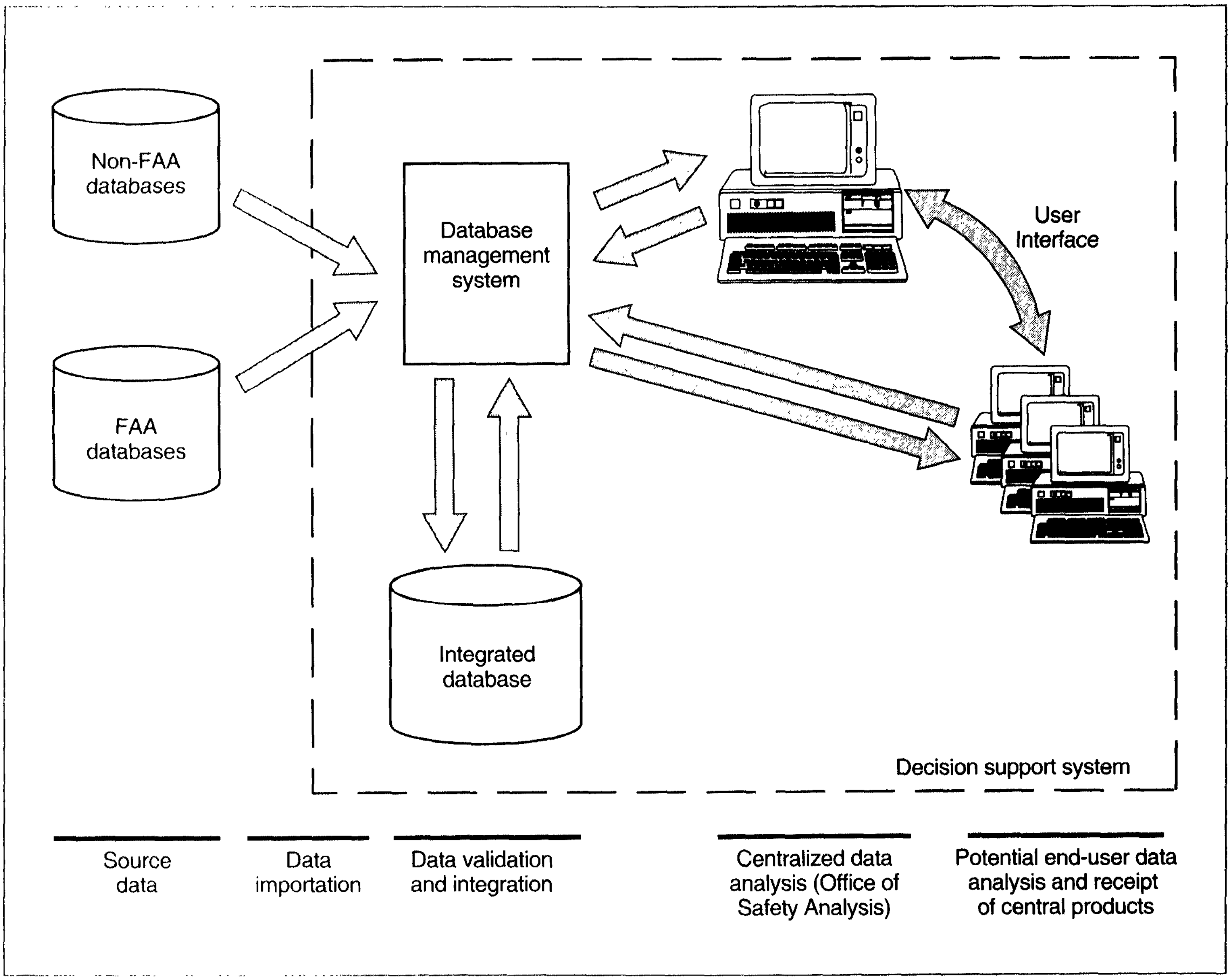
Source: FAA.

Note: Actual display in color; this example modified slightly to permit meaningful reproduction in black and white.

According to the NASDC program manager, 90 percent of the decision support system will be made up of commercial, off-the-shelf software packages. New software development will only be required to customize the commercial products and develop the interface between them. While the program manager would not specify the number of lines of code to be developed, he stated that the programs to integrate the commercial products will be few in number and not large.

NASDC is using a prototyping methodology to develop the decision support system. Development of the initial prototype began in 1990 and was completed in fiscal year 1991. Implementation of the full system is planned in fiscal year 1997. The current prototype has successfully demonstrated the capability to import files from the three NASDC databases into a temporary database management system for on-line, interactive query and analysis. Figure VI.2 provides an overview of the decision support system's functions.

Figure VI.2: Overview of Decision Support System



Past Reporting on Unreliability of FAA Databases

Since 1988 we and others have reported on the unreliability of FAA's safety-related databases. For example, in our 1988 report on the feasibility of assessing safety records of individual airlines, we concluded that none of FAA's incident databases could provide a satisfactory basis for developing indicators of safety because the data were unreliable, incomplete, and inconsistent. In a 1990 letter to the then-Administrator, James Busey, we stressed the need for validating the data's correctness and completeness before incorporation into any management information system, especially a program of safety indicators.

In response, FAA's Director, Office of Safety Analysis, agreed, stating that improving data quality would require "long term, sustained effort." Even last year we reported that FAA's database designed to provide information for planning and overseeing its inspection program is incomplete and inaccurate. We concluded that without reliable data in this area, FAA cannot determine with assurance whether inspection priorities have been achieved, whether follow-up activities are adequate or are being completed in a timely manner, and whether inspection resources are being effectively used. A bibliography of our reports is provided at the end of this report.

Internal FAA evaluations and Department of Transportation Inspector General reports have also raised this issue. In a 1988 memorandum, former Administrator Allan McArtor acknowledged that FAA lacked a focal point for safety data, that management of safety data was fragmented within the agency, and that FAA components' ability to provide accurate, comprehensive, and speedy information varied significantly. A 1989 memorandum to the Administrator from the Assistant Inspector General for Auditing mentioned that FAA could not vouch for the accuracy or timeliness of statistics derived from the Enforcement Information System. Finally, even industry has complained. A 1988 letter from a major airline called "for the most part worthless" FAA's data on accidents/incidents and its data on serious aircraft malfunctions.

Major Contributors to This Report

Information Management and Technology Division, Washington, D.C.	Randolph Hite, Assistant Director Prithviraj Mukherji, Technical Adviser Lynne Goldfarb, Publishing Consultant
Los Angeles Regional Office	Allan Roberts, Assistant Director Roderick Moore, Evaluator-in-Charge Matthew Villarreal, Staff Evaluator

Related GAO Products

Aviation Safety: Slow Progress, Uncertain Future Threaten FAA Program To Measure Safety (GAO/T-IMTEC-92-12, Apr. 1, 1992).

Aviation Safety: Problems Persist in FAA's Inspection Program (GAO/RCED-92-14, Nov. 20, 1991).

FAA Information Resources: Agency Needs to Correct Widespread Deficiencies (GAO/IMTEC-91-43, June 18, 1991).

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Department of Transportation: Enhancing Policy and Program Effectiveness Through Improved Management (GAO/RCED-87-3, Apr. 13, 1987).

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