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DEVELOPING AND IMPLEMENTING A CONTINUING ANALYSIS AND SURVEILLANCE SYSTEM

U.S. DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Flight Standards Service
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PREFACE

This advisory circular (AC) provides information on how to implement a continuing analysis and surveillance system (CASS), which is required for certain types of air carriers and commercial operators under Title 14 of the Code of Federal Regulations (14 CFR), §§ 121.373 and 135.431. A CASS is a quality management system for air carriers and commercial operators that monitors and analyzes the performance and effectiveness of inspection and maintenance programs.

This AC is one method of compliance with the requirements of 14 CFR. Instead of following this method, the applicant may elect to follow an alternate method, provided that method is acceptable to the Federal Aviation Administration (FAA). Because the method of compliance presented in this AC is not mandatory, the term "should" used herein applies only to an applicant who chooses to follow this particular method without deviation. A CASS should be tailored to each specific operation; therefore, this AC cannot provide a single means of compliance that applies to all operators required to have a CASS.

This AC and the FAA's Continuing Analysis and Surveillance System (CASS) Description and Models Report (2002) provide information about the FAA's expectations regarding industry implementation of a CASS. As required by §§ 121.373 and 135.431, a CASS monitors an operator's inspection and maintenance programs for compliance with applicable requirements, including FAA regulations and manufacturer instructions. The FAA encourages operators to also consider additional standards for use in a CASS, such as industry best practices or other government regulations and guidance relevant to inspection and maintenance activities.

/s/ James J. Ballough
Director, Flight Standards Service

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CHAPTER 1. INTRODUCTION

100. Purpose of this AC.

a. This advisory circular (AC) provides information on how to implement a continuing analysis and surveillance system (CASS), which is required for certain types of air carriers and commercial operators under Title 14 of the Code of Federal Regulations (14 CFR), §§ 121.373 and 135.431. A CASS is a quality management system for air carriers and commercial operators that monitors and analyzes the performance and effectiveness of inspection and maintenance programs.

b. This AC is one method of compliance with the requirements of 14 CFR. Instead of following this method, the applicant may elect to follow an alternate method, provided that method is acceptable to the Federal Aviation Administration (FAA). Because the method of compliance presented in this AC is not mandatory, the term "should" used herein applies only to an applicant who chooses to follow this particular method without deviation. A CASS should be tailored to each specific operation; therefore, this AC cannot provide a single means of compliance that applies to all operators required to have a CASS.

c. This AC and the FAA's Continuing Analysis and Surveillance System (CASS) Description and Models Report (2002) provide information about the FAA's expectations regarding industry implementation of a CASS. As required by §§ 121.373 and 135.431, a CASS monitors an operator's inspection and maintenance programs for compliance with applicable requirements, including FAA regulations and manufacturer instructions. The FAA encourages operators to also consider additional standards for use in a CASS, such as industry best practices or other government regulations and guidance relevant to inspection and maintenance activities.

101. Who should use this AC.

a. This AC is directed toward any operator that develops a CASS, whether they are required to do so or not. The following table explains which operators must have a CASS and which operators may choose to have one.

If you operate under...	You...
part 121	must have a CASS as required by § 121.373.
part 129 with an approved maintenance program for U.S.-registered aircraft	should have a CASS, as addressed in AC 129–4, Maintenance Programs for U.S.-Registered Aircraft under FAR Part 129.
part 135 and operate aircraft type-certificated for a passenger seating configuration, excluding any pilot seat, of 10 seats or more	must have a CASS as required by § 135.431.
part 91, 125, 133, 135, or 137 with aircraft having nine or fewer seats (§ 135.411(a)(1))	may be interested in developing a CASS because of the safety and other benefits it affords.

b. This AC is useful for any personnel directly involved in implementing a CASS, as well as operator senior management with responsibility for inspection and maintenance activities.

CHAPTER 2. BACKGROUND ON CASS

200. History of the CASS.

The FAA implemented the requirement for a CASS in 1964 in response to safety concerns and discoveries of weaknesses in the airworthiness programs of some operators, as revealed during accident investigations and FAA surveillance of operator maintenance activities. The FAA issued the requirement in conjunction with other regulations designed to strengthen requirements for air carriers' inspection and maintenance organizations and activities.

201. CASS regulations.

a. Requirement to have a CASS. This AC addresses certain key concepts in the CASS regulations, portions of which are italicized in the regulatory text quoted here for discussion later in this AC. Section 121.373(a) and (b) states:

(1) Each certificate holder shall establish and maintain a system for the continuing analysis and surveillance of the *performance* and *effectiveness* of its *inspection program* and *the program covering other maintenance*, preventive maintenance, and alterations and for the correction of any deficiency in those programs, regardless of whether those programs are carried out by the certificate holder or by another person.

(2) Whenever the Administrator finds that *either or both of the programs* described in paragraph (a) of this section does not contain adequate procedures and standards to meet the requirements of this part, the certificate holder shall, after notification by the Administrator, make any changes in those programs that are necessary to meet those requirements.

NOTE: The wording of § 135.431(a) and (b) is substantively identical.

b. Requirement to have inspection and maintenance programs. Except as otherwise provided in part 121, certificate holders under that part are required by § 121.367 to have an inspection program and a program covering other maintenance, preventive maintenance, and alterations. In accordance with § 135.425, the same requirement applies to operations under part 135 involving aircraft type-certificated for a passenger seating configuration, excluding any pilot seat, of 10 seats or more.

c. The elements of a maintenance program. An air carrier inspection/maintenance program includes the following nine elements:

(1) Accomplishment and approval of maintenance, including inspection;

(2) Airworthiness responsibility;

(3) A CASS;

(4) Contract maintenance;

(5) A maintenance manual;

(6) A maintenance organization;

(7) A maintenance recordkeeping system;

(8) A maintenance schedule; and

(9) Personnel training.

202. Purpose of a CASS.

a. If an operator fails to accomplish its inspection and maintenance programs according to its manuals and applicable requirements, or if the manuals have deficiencies that result in flaws in the inspection and maintenance programs, an aircraft may be approved for return to service when it is not airworthy. The FAA views the CASS as a continuous, system safety-based, closed-loop cycle of surveillance, investigation, data collection, analysis, corrective action, monitoring, and feedback for operators to use to continually monitor and correct any deficiencies.

b. The FAA expects that each operator designs its CASS to ensure it conducts its inspection and maintenance programs according to regulations and operator manuals, and that these programs are effective in achieving the desired result of consistently having only airworthy aircraft approved for return to service. For the CASS to yield this safety benefit, the FAA expects the operator's senior management to establish safety as its top organizational priority. To reach this goal, all personnel need to embrace organizational goals and act jointly to achieve them.

203. Structure of a CASS.

a. The intent of the regulations governing inspection and maintenance programs is to ensure that at least the level of safety originally designed into an aircraft system is maintained and that the aircraft is airworthy. Both inspection and maintenance program functions are included in what is called a continuous airworthiness maintenance program (CAMP). Within a CAMP, however, an operator must have separate programs and functions to conduct inspection tasks and maintenance tasks.

b. There are two basic questions that the regulations require a CASS to address:

(1) Are you following your inspection and maintenance manuals and procedures? The continuing analysis and surveillance of the *performance* of inspection and maintenance programs refers to the process of collecting and evaluating information to determine that the inspection and maintenance programs are being executed according to regulations, operator manuals, and other applicable requirements. This portion of the CASS consists of conducting and analyzing the results of audits and audit trends to verify that the operator is following its inspection and maintenance programs as written and is properly performing maintenance as intended. The analysis conducted in this area of a CASS also identifies weaknesses, if any, in the systems and procedures used to carry out the inspection and maintenance programs.

(2) In following your manuals and procedures, are you producing consistently airworthy aircraft? The continuing analysis and surveillance of the *effectiveness* of the inspection and maintenance programs refers to the process of collecting and evaluating operational data to verify the inspection and maintenance programs are not only being performed as written but also are producing the desired results. The desired result is that aircraft are always airworthy when they are returned to service with a level of reliability consistent with the goals of the inspection and maintenance programs. "Reliability" is used here as a broad term and is an expression of dependability and the probability that an item—including an aircraft, engine, propeller, or component—will perform the required function under specified conditions without failure for a specified period of time. Testing for effectiveness consists of collecting and analyzing operational performance data such as:

- Maintenance-related delays and cancellations;
- Failure rates of parts and components after they are approved for return to service;
- Discrepancy rates of aircraft after heavy maintenance; and
- Related trend analysis.

c. The regulations require an operator to include, as part of its CASS, provisions to correct any deficiencies in its inspection and maintenance programs, regardless of whether the programs are actually conducted by the certificate holder or by another person (i.e., contracted services). The regulations also provide authority for the FAA to require the certificate holder to make changes in the inspection and maintenance programs if they do not meet the requirements of part 121 or part 135, as applicable.

d. A well-structured CASS can assist an operator in taking a systems safety approach to its inspection and maintenance programs through recognition of the interaction of all the elements within an air carrier's systems and subsystems. The systems consist of interrelated processes that comprise personnel, procedures, materials, tools, equipment, facilities, and software operating in a specific environment to perform a particular task or achieve a defined purpose, support, or mission requirement for an air carrier.

e. An unairworthy aircraft can be the result of the actions of a wide variety of organizations and/or functions, in addition to those associated with inspection and maintenance. These organizations and/or functions include senior management, flight operations, ground operations, and others. A good CASS would consider the potential role of these organizations and/or functions through effective surveillance and complete root cause analysis. These issues are covered in greater detail in paragraphs 501 – 503 of this AC.

f. When performing its surveillance and analysis functions, persons responsible for a CASS are encouraged to use the system safety categories of safety attributes, safety culture, communication, accountability, training programs, and potential problem areas when identifying hazards and managing risks. The FAA defines safety attributes as the following:

(1) Authority. There is a clearly identifiable, qualified, and knowledgeable person with the authority to establish and modify a process.

(2) Responsibility. There is a clearly identifiable, qualified, and knowledgeable person who is accountable for the quality of a process.

(3) Procedures. There are documented methods for accomplishing a process. The procedure description should answer the basic questions of who, what, when, where, and why, as appropriate.

(4) Controls. There are checks and restraints designed into a process to ensure a desired result.

(5) Process measurement. The air carrier measures and assesses its processes to identify and correct problems or potential problems.

(6) Interfaces. The air carrier identifies and manages the interactions between processes.

g. Systems safety and, therefore, CASS functions are built around principles of what is commonly referred to as risk management. This includes identifying hazards; evaluating how severe the hazards' consequences would be and how likely they are to occur (risk assessment); and developing, implementing, and evaluating measures to address the identified risks and program deficiencies throughout a system's life cycle to achieve an acceptable level of risk (risk management). Operators perform these functions on some level currently, although the degree of formality and sophistication depends on the size and scope of the operation as well as the level of training operator personnel have in risk management. In a CASS, the FAA expects a formal risk management process (system safety) with safety and compliance as the top priorities. A formal process is structured, but not necessarily complex or expensive.

h. A CASS is intended to give operator management (and the FAA) a realistic picture of the frequency and nature of deficiencies occurring in the operator's inspection and maintenance programs, and the opportunity to correct them. If company personnel at any level perceive that their jobs are at risk by collaborating in this system, they are likely to withhold information or bias the analysis for self-protection. The FAA suggests that the operator design its CASS to emphasize the end goal of enhancing safety by evaluating and improving the inspection and maintenance programs. The analysis and surveillance should not be perceived or intended as a method of identifying individuals who have committed errors simply to take some sort of disciplinary action. Human error is inevitable, but the question for a CASS to answer is how to better design the inspection and maintenance programs to preclude errors from encroaching on system safety or resulting in noncompliance.

i. A particular challenge for any CASS is to overcome complacency that may be caused by the high degree of redundancy and dependability in modern aircraft systems. Operators need to place high priority on the continuing analysis and surveillance of their inspection and maintenance programs because the potential consequences of deficiencies in those programs are very serious.

j. Due to the wide range of affected operators, it would be unrealistic to set forth a single means of compliance for all operators to follow. Just as each operator has its own inspection and

maintenance procedures manuals, each operator should have its own CASS. An operator should design a CASS appropriate to the size and sophistication of its operation.

CHAPTER 3. USING THIS AC TO DESIGN A CASS

300. Types of operators this AC helps.

a. The CASS applies to many types of operators, ranging from small operators of one or two aircraft to operators with several hundred turbojet aircraft. The aircraft may include helicopters or airplanes. The operators may provide scheduled or unscheduled service, and may operate under part 121 or part 135. These functions affect the size and structure of an operator's inspection and maintenance organizations. Additionally, an operator conducting operations under part 91, 125, 129, 133, 135 (nine or fewer seats), or 137, while not required to have a CASS, may also find this AC useful if it decides to implement a CASS.

b. A primary difference among operators in regard to CASS design involves the personnel assigned to accomplish CASS-related duties. A smaller operator may have fewer assigned personnel, and it may have to draw upon personnel normally assigned to other functions to fulfill CASS functions part-time. The operator may even need to use outside resources such as contract personnel to supply special expertise or independent review if its organization lacks the necessary special skills or training, or has an insufficient number of personnel to fulfill the CASS functions. A larger operator may have a significant number of personnel assigned full-time to CASS functions.

301. Approach of this AC.

a. This AC primarily addresses the functions of a CASS. The main text of the AC (chapter 5) presents the basic functions the FAA expects to see included in any CASS.

b. In appendixes 1, 2, and 3, we present examples of how three different types of operators might accomplish these CASS functions and satisfy the intent of this AC. The examples are not intended as a menu from which an operator may select a CASS. Rather, the examples are intended to demonstrate how an operator might design a CASS suitable for its operation. Each appendix contains descriptions of procedures based on likely available resources for a different type and size of operator. The number and type of airplanes operated is not particularly important. For example, the small on-demand air carrier operating under part 135 with two Saab 340B airplanes would probably meet the intent of this AC in essentially the same way as a small part 121 operator with one Boeing 727. The operator will need to develop its own procedures and use the terminology (for example, designating the personnel or organizations involved in different aspects of the CASS) that best fit its operation. For that reason, any job titles in this AC are for illustration; they are not requirements or even recommendations. Appendix 4 is a list of sample CASS manual/document contents. Appendix 5 lists related publications and the publications used to produce this AC.

CHAPTER 4. CASS IN THE OPERATOR ORGANIZATION

400. CASS documentation.

The operator should describe its CASS policy and procedures in writing. They can be in a paper or electronic document, or other comparable record. For example, the operator may accomplish this in a detailed chapter or section within a general maintenance manual or in a separate CASS manual associated with the general maintenance manual. The intent is that policy and procedures not be simply oral understandings.

401. Written policy and procedures.

The CASS policy and procedures should:

a. Recognize and treat the CASS as a coordinated system rather than as audit and data collection activities dispersed within the operator's inspection and maintenance programs. CASS personnel do not necessarily have to be contained within a single department or office of the operator's organization. However, the policy and procedures should identify all functions related to the CASS, rather than assume that because an audit or data collection function exists somewhere within the organization, it automatically satisfies the CASS requirement with no further coordination necessary.

b. Identify any programs, such as an optional FAA-approved reliability program, used to satisfy a major portion of the CASS. The CASS documentation may refer to the documentation for that other program rather than repeat the contents. The relationship/interfaces between the CASS and the other program should be clear and address responsibility and feedback issues to ensure CASS objectives are met.

c. Be based on principles of systems safety analysis.

d. Clearly identify the positions within the company with authority and responsibility for the CASS. The operator may use and define the terms as it sees fit, but these concepts (briefly defined above in the discussion of systems safety, paragraph 203f) should be addressed. The definitions below would have meaning within the context of an air carrier's organization and would not necessarily relate to the traditional concept of FAA regulatory authority.

(1) Authority. For purposes of this AC, "authority" with regard to the CASS means the power to create or modify fundamental policy or procedures without higher level review or approval. The person with authority for the CASS may design or change the CASS without having to seek approval from a higher level of management. CASS procedures should include how to modify the CASS.

(2) Responsibility. For purposes of this AC, "responsibility" with regard to CASS means the obligation, with attendant accountability, for ensuring tasks and functions are successfully accomplished in accordance with applicable policies, procedures, and standards. This work may be accomplished directly by the person with responsibility, or the work may be delegated. The person with responsibility for the CASS has the obligation to carry out the functions of the CASS, including overseeing and managing any personnel to whom CASS

functions and duties are delegated. Note that for smaller organizations where personnel share duties and may only carry out CASS functions part-time, this oversight and management responsibility relates only to those part-time tasks.

A single person or position within the operator should have authority for the CASS, and a single person or position within the operator should have overall responsibility for managing and implementing the CASS. A single person may have both responsibility and authority for the CASS. That person might also have responsibility for other functions as well as the CASS. It would be common for the person with responsibility for CASS functions to delegate some or much of this work to others within the operator, depending on the size and staffing of the operator. What the FAA expects is clear responsibility for the overall CASS so that there is not a fragmented system with high risk of confusion over who is responsible for a given task.

Personnel with CASS responsibilities and duties should be as independent as possible from the day-to-day operations of the inspection and maintenance program. Ideally, the personnel conducting audits would work in separate departments from the departments performing the actual inspection and maintenance activities of the operator. However, this is not necessarily feasible for small operators. At small operators, personnel performing CASS functions, particularly audits, may consist of one or more of the following:

- "Borrowed" personnel from certain other shops or departments. The operator's procedures should include ways to avoid having these individuals assigned to audit areas where they normally work.

- The company owner or chief executive officer, particularly if there are no other employees and the CASS audits are focused on outside vendors and maintenance providers because all or most of the actual inspection and maintenance work is accomplished through contracts.

- Outside resources contracted to perform audits and analysis for the company.

- Others deemed qualified by the operator to provide the operator independent audit, operational data collection, and analysis services that fulfill the requirements of a CASS as described in this AC.

e. Address the need for fluid communications and coordination among the persons with authority, responsibility, and duties related to the CASS.

CHAPTER 5. MAJOR CASS ACTIVITIES

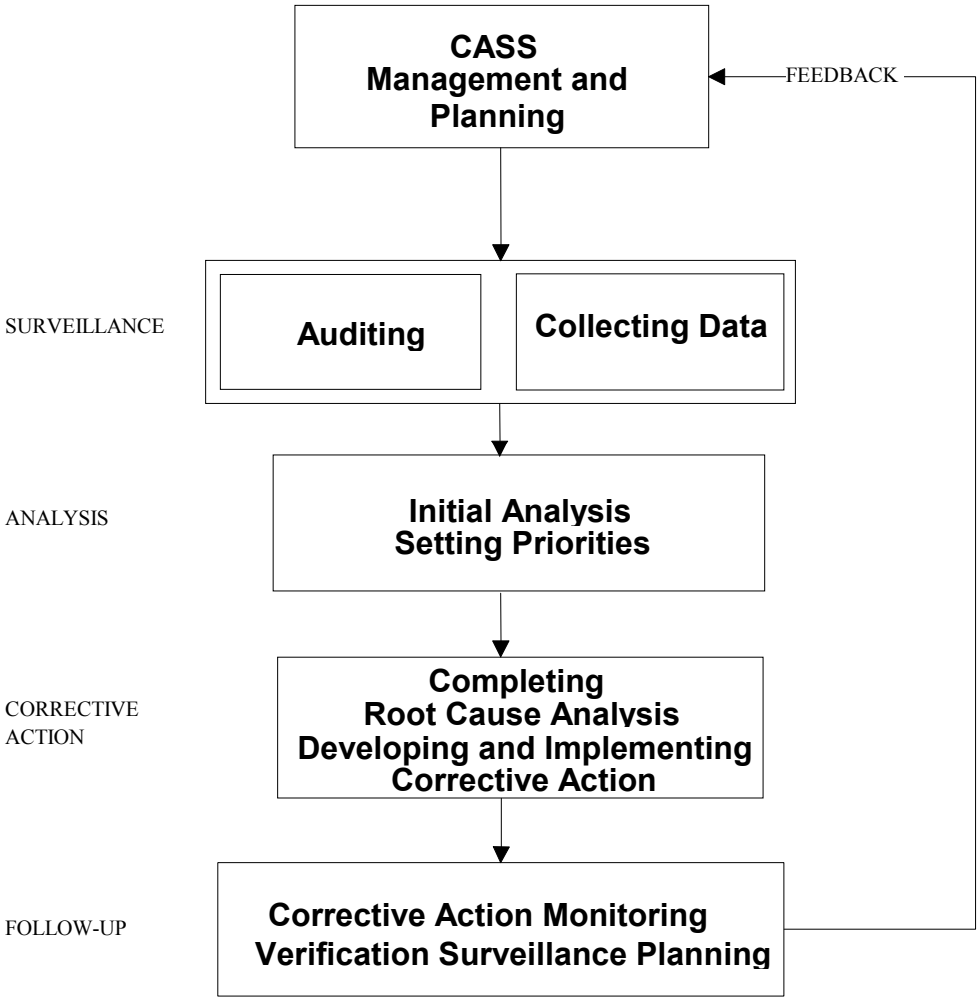
500. Summary of a CASS.

The regulations require that a CASS accomplish surveillance and analysis of the inspection and maintenance programs from two perspectives: verifying performance and verifying effectiveness. The first two steps in the CASS process (surveillance and analysis) are carried out in two different ways. One is based on auditing, and the second is based on operational data collection and analysis. The results of the two types of surveillance and analysis feed into the third and fourth basic CASS activities: corrective action and follow-up. The following table summarizes these four basic steps of a CASS within a system safety mode.

Verify *Performance* of Inspection and Maintenance Programs	Verify *Effectiveness* of Inspection and Maintenance Programs
1. Surveillance: Audit process. • Create a plan based on risk assessment. • Perform transaction audits. • Perform systems evaluation. • Identify hazards.	**1. Surveillance:** Data collection process. • Select data sets. • Collect operational data. • Collect equipment failure data. • Note trends, anomalies, and potential hazards.
2. Analysis: Accomplish risk assessment and preliminary root cause analysis.	**2. Analysis:** Investigate adverse indicators; accomplish risk assessment and preliminary root cause analysis.
3. Corrective Action: Complete final root cause analysis, corrective action options, risk assessment, decisionmaking, and developing and implementing a corrective action plan.	
4. Follow-up (Performance Measurement): Monitor corrective action, verification, and follow-up surveillance planning.	

Figure 5-1 summarizes the flow of the four basic steps of the CASS, which are described in further detail in paragraphs 501 – 504.

Figure 5-1. The Four Basic CASS Activities: Surveillance, Analysis, Corrective Action, Follow-up



The following two figures expand on the "Auditing" and "Collecting Data" activities displayed in figure 5-1. Figures 5-2 and 5-3 show the variety of functions within an operation that may affect the inspection and maintenance programs. An operator should consider these in its surveillance and root cause analysis process, as appropriate.

Figure 5-2. Auditing Portion of the Surveillance Process

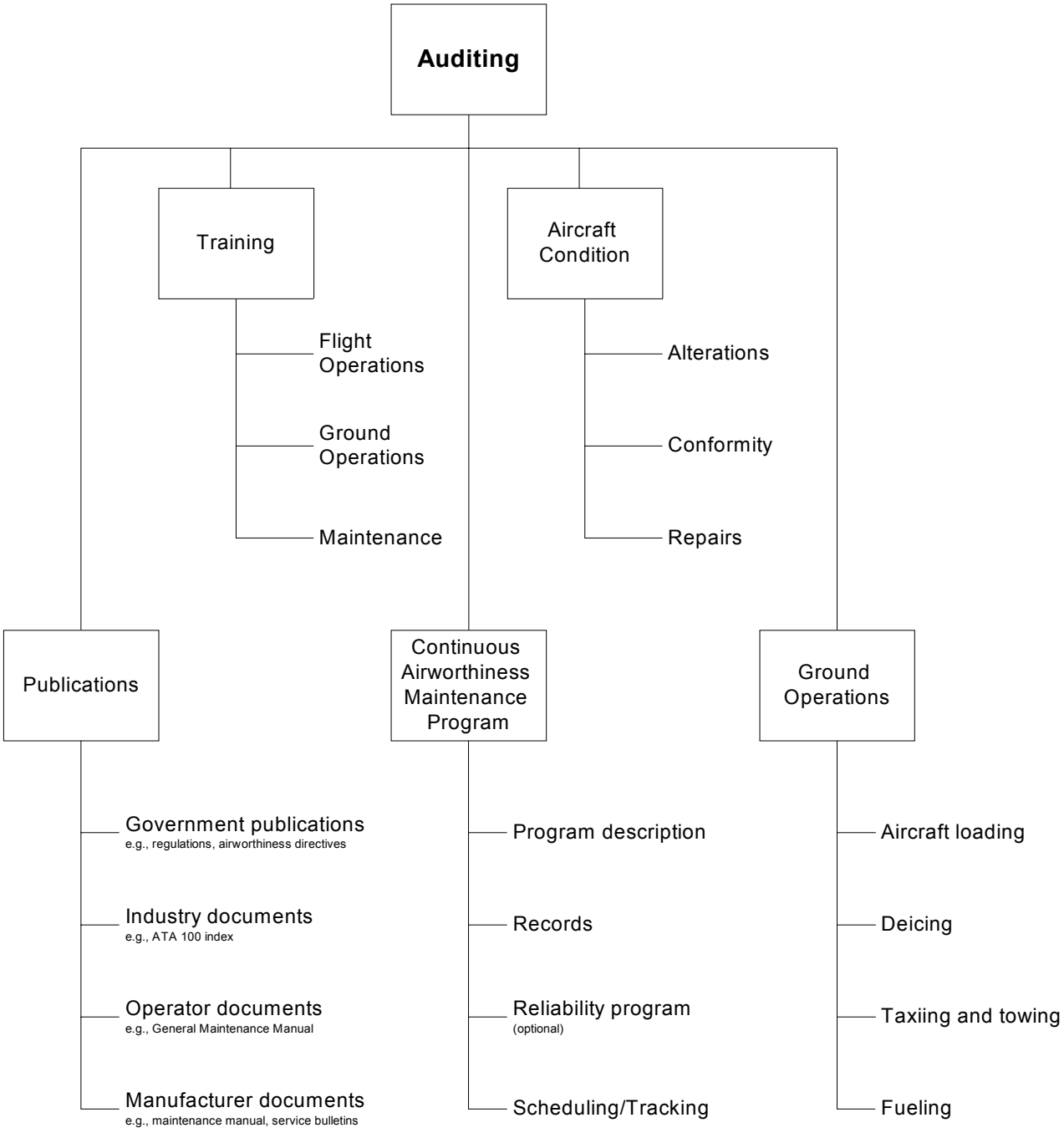
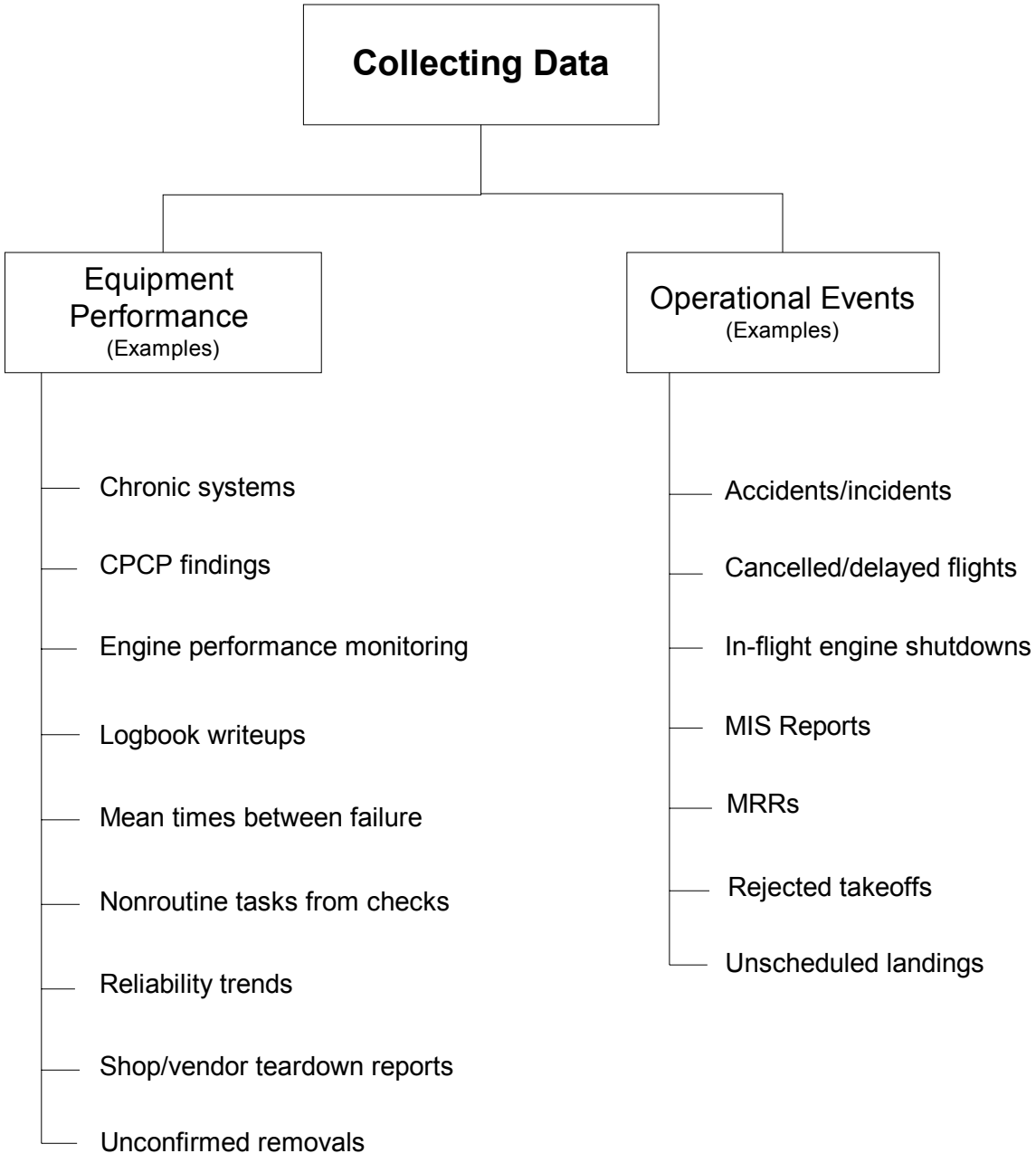


Figure 5-3. Data Collection Portion of the Surveillance Process



501. Verifying the *performance* of inspection and maintenance programs.

a. Surveillance of the performance of inspection and maintenance programs.

(1) Definition of "audit" within a CASS. The main tool for surveying (assessing) whether the operator is properly performing (executing) its inspection and maintenance programs is audits. For purposes of a CASS, an audit is a formal examination of the activities of a department or area of an operator's inspection and maintenance programs based on an established standard such as the applicable manual. Audits are intended to ensure operator inspection and maintenance personnel and outside maintenance providers comply with the operator's manual, program, and all applicable requirements.

(2) Audit procedures. The operator should have written procedures to guide its auditing process, including the scheduling of audits. The CASS addresses both internal and external audits. Internal audits are audits the operator conducts within the company. External audits are audits the operator conducts of vendors supplying parts and services to the operator. CASS procedures should include a methodology for determining priorities and for establishing and adjusting audit cycles (for example, 12-, 18-, 24-, 36-month cycles) so that resources are focused on the most pressing issues. This is a risk assessment and risk management process (see paragraph 501a(3) below for further explanation of risk assessment and risk management).

Although the majority of the inputs to this process would be generated internally, one additional input may be the results of outside audits of the operator or its vendors conducted by entities other than the operator. For example, the results of audits or inspections conducted by the FAA or the Department of Defense (DoD) may be useful by providing an operator with:

- Specific findings requiring root cause analysis and possible corrective action (activities discussed later in this AC), and
- Information useful in focusing the operator's own audits and operational data collection.

The operator may approach this initial scheduling task in many different ways, ranging from resource allocation based on company experience and very basic analysis to use of a sophisticated, software-supported risk analysis process. Within this range of possible methodologies, the FAA expects the operator's CASS procedures to contain a process to systematically make those decisions that are compatible with the size and complexity of the operations. The FAA encourages operators to make this process as structured as possible. The operator should place priority first on safety and regulatory compliance, and second on issues of operational efficiency. However, an effective CASS meets all three of these objectives.

(3) Prioritizing surveillance resources. Essentially, any methodology selected to prioritize surveillance resources (as well as to formulate corrective action decisions later in the process) involves principles of risk assessment. Risk assessment is a concept applicable in many aspects of an aviation operation (see Order 8040.4, Safety Risk Management, for additional information). This FAA order is an example and is not the only source of risk assessment

procedures; however, it provides insight into FAA expectations. The FAA encourages operators to incorporate the principles of this systematic process to:

- Establish a plan, including the scope of the process and priorities (for example, detect and prevent noncompliance);
- Specify the areas of concern for surveillance and analysis (personnel, maintenance and inspection programs and organizations, operations, aircraft, facilities, systems);
- Identify hazards or potential threats to the operation;
- Determine how likely such hazards are to be realized and actually cause harm;
- Determine the severity of the consequences if the hazard is realized;
- Express a combination of the likelihood and severity of harm as "risk"; and
- Evaluate the appropriate response to the identified risk.

A CASS should take into account four principal potential sources of hazards:

- Personnel (hiring, capabilities, interaction);
- Equipment (design, maintenance, logistics, technology);
- Workplace (environment, sanitation); and
- Organization (standards, procedures, controls).

A number of quantitative and graphical tools exist in the industry to help determine the gradations of a risk (high, medium, low) based on the likelihood of an unwanted event occurring and the severity of the consequences if it does occur. In the initial steps of the CASS process, the appropriate response involves setting surveillance priorities based on risk assessments aimed at maintaining compliance and safety in inspection and maintenance. A CASS risk assessment, through the feedback loop, helps to set the audit and data collection priorities enhancing the focus of surveillance. The process is best accomplished by an interdisciplinary team, guided by CASS management but involving representatives of the relevant technical areas.

To identify the areas to audit and to set priorities, consider factors in outside reports. These could include inspections, reports, special studies, or audits conducted by outside entities such as the FAA, (DoD), Department of Transportation, Office of the Inspector General, or National Transportation Safety Board. Outside reports may address:

- Information specific to the operator or its vendors;
- Information related to the industry as a whole and of interest to the operator; and/or

- Information about an accident, incident, procedure/process, or equipment type that is relevant.

(4) Audit materials. The operator should equip CASS auditors with checklists to ensure consistency and completeness of audits. The person responsible for the CASS should ensure the checklists are updated as needed. An auditor should also be permitted flexibility to ask questions not contained on the checklist if he or she finds an area that requires further investigation.

(5) Areas to be audited. The operator's procedures should include identification of all areas to be audited along with a process for updating this list. The following list presents examples of areas operators should consider for routine audit. A CASS audit should verify that:

- Manuals, publications, and forms (paper and electronic versions) are useable, up-to-date, accurate, and readily available to the user;
- Maintenance and alterations are performed according to the methods, standards, and techniques specified in the operator's manuals, including ensuring major repairs and alterations are properly classified and accomplished with approved data;
- Parts and components are properly stored, dispensed, identified, and handled;
- Airworthiness directives are appropriately evaluated, accomplished, and tracked;
- Maintenance records are generated in accordance with manual procedures and are complete and correct;
- Required inspection items are identified and addressed according to the operator's procedures;
- Airworthiness releases are executed by authorized persons according to the operator's procedures;
- Shift turnover records, work interruptions, and deferred maintenance are accomplished according to applicable procedures;
- Maintenance facilities and equipment, including base and line stations and contract maintenance providers' facilities, are adequate;
- Personnel, including those of contract maintenance providers, are trained and qualified to accomplish their duties;
- Tools and equipment are properly calibrated;
- Requirements for specialized tools or training are met, such as for nondestructive testing, category II/III operations, and run-up/taxi;

- Computer programs (software) for the inspection and maintenance programs are performed in accordance with specifications;

- Vendors and suppliers provide services and products according to the operator's policies and procedures; and

- Each aircraft released to service is airworthy.

(6) Objective of CASS audits. CASS audits should primarily be proactive, searching out potential problem areas before they result in undesirable events. However, CASS procedures may also address how to direct audits in response to events or a series of events. For example, rejected takeoffs, unscheduled landings, in-flight shutdowns, accidents, or incidents may indicate the need for special audits or surveillance under a CASS. The purpose of a CASS is to detect and analyze trends for indications of program weaknesses or deficiencies. For example, CASS auditors would not necessarily investigate a single maintenance-related rejected takeoff, although the maintenance program would. A CASS would, however, consider whether that instance indicated a need to focus audits on a particular issue.

(7) Informal communications within CASS. Auditors and analysts should maintain informal lines of communication with personnel in the production departments so that inspection and maintenance personnel can discuss concerns they may have. Through this informal communications process, the operator can learn about potential hazards in the system. For example, the operator may learn about an event that might have occurred but, because of some intervention, did not. This event is known to shop personnel but is otherwise difficult or impossible to detect in routine audits. With informal lines of communication open to shop personnel, a CASS may detect this near-event. The FAA suggests that the operator's CASS procedures address how to encourage this type of communication and interaction.

b. Analysis of audits.

(1) Root cause analysis. A risk assessment process tells operators where to allocate resources and helps them understand what is found. Audit results should undergo risk assessment and preliminary root cause analysis to identify a deficiency, or potential deficiency, in any aspect of inspection and maintenance programs. This preliminary analysis helps CASS personnel determine the level of priority the issue merits and what type of additional technical expertise may be required to complete the root cause analysis and evaluate corrective action options.

Root cause analysis treats errors as defects in the system rather than in a person. Root cause analysis looks beyond the symptom to find the organizational defect that permitted an error to occur to correct the fundamental problem, and to prevent recurrence. The more thorough the analysis, the greater the likelihood the operator will uncover why the system deficiency occurred and how the organization can respond definitively. The process starts during the audit itself, as auditors must collect information conducive to later analysis. If a CASS is to uncover a procedural weakness, for example, information about the procedure must be collected. This should be factual and objective information, not premature judgment about root cause. Root cause analysis is key to any complete CASS, even though procedures may vary in complexity from operator to operator.

(2) Objective of audit analysis. The objective of this analysis is to allow the operator to address the problem in such a way as to avoid recurrence of the deficiencies. To the extent possible, the operator should set forth in the CASS documentation the analysis process. The analysis process should be as objective as possible to avoid any tendency to promote individual or commercial interests. The system should also place priority on finding the systemic or root cause of a program deficiency over seeking to assign personal blame, at any level of the organization, for an error.

While audits are designed mainly to verify that an operator is performing inspection and maintenance in accordance with its manual, the regulations, and applicable requirements, auditors and analysts should also be alert for system deficiencies. That is, there may be procedures in the manual that are correctly followed, but that have become outdated, conflict with other manual procedures, or for some other reason are in need of change. Auditors and analysts should be encouraged to be inquisitive and think in terms of "what if?" so that the CASS functions proactively, detecting problem areas or trends before they lead to an accident, incident, or infraction of regulations. For example, what if event *x* occurred in conjunction with observed condition *y*? This approach is closely tied to the CASS analysis process but would require an analytical approach that permeates the CASS organization, from determining audit priorities and scheduling through auditing and analyzing, and including monitoring and evaluating corrective actions.

(3) Managing data from audit analysis. The audit analysis process is not typically as oriented toward quantitative analysis as the operational data analysis discussed below. However, operators may find it useful to manage the data through database or quantitative applications. The FAA emphasizes that this is an approach that does not have to be complicated or costly. The level of formality and sophistication should match that of the operator.

502. Verifying the *effectiveness* of inspection and maintenance programs.

a. Surveillance of the effectiveness of inspection and maintenance programs.

(1) Collecting operational data. The main tool for determining whether an operator's inspection and maintenance programs are effective is collecting and analyzing operational data focused on the equipment. Data should be collected that measures the output of the inspection and maintenance programs. The FAA does not intend to mandate the specific data an operator should collect. However, the FAA does expect an operator to have a process to ensure the data collected are adequate to meet the intent of the CASS requirement and are useful. The FAA expects an effective selection process and periodic review process, not specific data elements that may not fit a given operator's situation.

(2) Types of operational data. Operational data can be divided into routine or unplanned (nonroutine). Examples of routine data are:

- Adjustment and/or calibration of equipment;
- Aircraft logbooks, including maintenance deferred in accordance with the minimum equipment list/configuration deviation list;

- "Chronic" systems that alert for repeat writeups in a specified time period (for example, 10 to 15 days);
- Corrosion prevention and control program findings;
- Engine condition monitoring information;
- Flight delays and cancellations related to mechanical issues;
- Results of fuel audits;
- Individual item failure rates;
- Mechanical reliability reports, mechanical interruption summaries, and similar data;
- Nonroutine maintenance;
- Teardown reports;
- Unscheduled parts replacement or unscheduled maintenance; and
- Vendor repair station information.

Operational data also includes reactive data collection and analysis responding to emergency or other nonroutine events, such as:

- Accidents and incidents;
- In-flight engine and propeller separations and uncontained engine failures;
- In-flight engine shutdowns;
- Rejected takeoffs;
- Unscheduled landings due to mechanical issues;
- Lightning strikes; and
- Hard landings.

As with reactive audit surveillance, a CASS generally approaches problems from the analytical, systems perspective. For example, in response to one or more rejected takeoffs, a CASS might focus the operational data collection and analysis to determine if a pattern in rejected takeoffs was evident, or if other types of data might be examined in relation to the rejected takeoff situation.

The above data sets are presented only as examples. Although the data sets are oriented toward equipment, this area of a CASS may also collect other types of data, such as information on types of maintenance errors experienced by the operator.

(3) What to include in CASS documentation regarding collecting operational data. The operator's CASS documentation should include a means of identifying data that is relevant and useful for that operator to use in monitoring the effectiveness of its specific inspection and maintenance programs. The operator should periodically review and reevaluate the usefulness of the data it collects and analyzes to accomplish this portion of the CASS.

b. Analysis of operational data. CASS procedures should:

(1) Provide analysts with an understanding of the potential significance of each data set and how to process the data to understand its significance. This may require:

- Statistical analysis, such as comparing the frequency of certain events or equipment failures with a determined norm, or

- Qualitative analysis, to evaluate reports of certain types of events.

NOTE: This process is not necessarily the same as what would be used in an FAA-approved reliability program.

(2) Emphasize that the analysis of operational data should consider root causes of negative trends or anomalies. This preliminary root cause analysis, including human factors, may require collaboration with technical personnel in the affected areas or specialists in engineering and reliability departments.

(3) Delineate the roles of the CASS analysts as well as other departments or personnel in the analysis of operational data.

Some operators select a system that uses alerts or warnings if results of the analysis exceed certain predetermined parameters. A CASS should not rely completely on such alerts to the exclusion of analysts' judgment. The FAA's expectation of a CASS in this regard is that the operator have a complete, written procedure to review and analyze the operational data collected and to determine when further review is necessary.

503. Final root cause analysis and corrective action.

While the surveillance and analysis steps differ for the verification of the *performance* of the inspection and maintenance programs versus verification of the *effectiveness* of those programs, the process merges when responding to CASS findings. The two types of analyses identify potential deficiencies in the inspection and maintenance programs. In responding to these findings and analyses, the objective of a CASS is to determine the root causes of program deficiencies and address them appropriately, regardless of the perspective from which the deficiencies are found. Note that the discussion is focused on a CASS function, not an organization. For a given operator, that function might be performed by more than one organization.

Generally, the area responsible for surveillance results will present these results to the technical or production area of the operator with a preliminary analysis of the collected information and, in some cases, possible underlying causes of the problem. Personnel in technical or production areas complete the root cause analysis (if necessary) and develop proposed corrective action alternatives.

a. Final root cause analysis.

(1) Preparing for root cause analysis. Analysis of audit findings or operational data requires evaluating mechanical and human performance, or other results generated by the CASS process, to determine the condition of a process, maintenance practices, or equipment. In the case of operational data, analysis begins with comparison of the data to a standard representing acceptable performance. The standard may be in the form of an average or other means of calculating a reference. The standard may be set by the FAA, industry common practice, or the operator, as appropriate.

The key is to have a CASS structure that addresses the basic disciplines and elements involved in finding and correcting program deficiencies. The CASS procedures should note that in performing root cause analysis, all relevant areas should be considered, including the role of senior management, policies, procedures, and communications.

(2) Applicability of root cause analysis. Root cause analysis applies to both audit findings and analysis of results and trends in the operational data. For example, either audits or operational data analysis may point to maintenance errors being committed because of inadequate training. Analysis should not stop with simply determining which mechanics were inadequately trained and then training them. Rather, the analysis should determine why the training breach occurred and consider areas in management, communications, scheduling, or training program design that may be involved.

(3) Principles and considerations of root cause analysis. Principles and considerations of root cause analysis are closely related to those of risk assessment, particularly in terms of the thoroughness of the analysis. Both processes consider not simply the person involved in an issue (for example, the mechanic made a mistake), but all aspects of the organization in which that person works. This approach has the premise that human error is a consequence rather than a deliberate action, and that proactive measures and continuous reform of different aspects of the processes and organization can address "latent conditions" in the system and increase the system's resistance to operational hazards. The term latent conditions refers to flawed procedures or organizational characteristics capable of creating hazards if the right conditions or actions occur.

Root cause analysis should consider two major areas:

- **Systems.** Systems analysis plays an increasingly important role in a CASS because of the increasing complexity and variety of operations, equipment, and organizations. Systems analysis emphasizes a coordinated approach to an enterprise, including specific written procedures and planning for all activities, clearly established authority and responsibilities, communications processes, and

methods of measuring results, detecting system errors, and preventing recurrence. This approach recognizes the wide range of interrelated issues potentially associated with a problem in the system, such as management policies, communications, and pilot technique, in addition to the inspection and maintenance activities themselves.

- **Human factors.** Human factors analysis looks at how humans communicate and perform in the work environment and then seeks to incorporate that knowledge into the design of equipment, processes, and organizations. This enhances safety and maximizes the human contribution, partly by designing systems to anticipate the inevitability of human error. Human factors include basic issues that can be addressed in audit checklists, such as whether there is adequate lighting for mechanics and inspectors to perform their work, and whether schedules permit personnel to be properly rested. But the discipline addresses a wider range of issues affecting how people interface with technology and the operational system, including:

    - Human physiology;
    - How people learn and perceive;
    - Equipment, technology, and documentation; and
    - Workplace.

  Operators should be aware that knowledge gained from human factors can help avoid maintenance and inspector errors, ensure that personnel initial skill sets match task requirements, ensure skills are maintained and improved, and enhance the work environment. This knowledge can help CASS analysts perform root cause analysis. Continuing with the previous example of inadequate training, with insufficient awareness of human factors issues, operators may trace a maintenance error to a mechanic or technician who appears to be insufficiently trained for the task, and determine that the solution is more technical training. Further analysis may reveal, however, that there are contributing flaws in equipment design, job cards, manuals, the work environment, or organizational procedures such as shift turnover that more training will not satisfactorily overcome. Or, it may turn out that a different kind of training, perhaps involving decisionmaking skills, is called for.

  The FAA is deeply involved in cooperative efforts with the industry and academia in promoting human factors in aviation. This field is rapidly evolving, particularly in its application to aviation maintenance. According to a study conducted for the FAA, which cited Boeing research, maintenance error contributes to a significant portion of air carrier accidents, with shift-turnover errors and work interruptions standing out as leading underlying causes. Based on the field's growing importance and the information available to industry, the FAA expects that

operators will apply concepts of human factors to their CASS surveillance and analysis.

CASS surveillance also should ensure root cause analysis, considering human factors, is part of the investigation of individual events by any personnel designated to respond to such events, such as rejected takeoffs. Otherwise, data reviewed in a CASS may be incomplete.

One challenge presented by the increasing emphasis on human factors is how to balance two seemingly contradictory purposes. On the one hand, the FAA and industry need to encourage personnel to cooperate in addressing system organization and design issues without inhibitions caused by fear of discipline or enforcement. On the other hand, in some cases, individual employees or the operator may bear a degree of culpability (for example, in deliberately bypassing important controls or committing a serious regulatory infraction in the commission of a maintenance error). In some instances, disciplinary action or even FAA administrative or legal enforcement may be indicated. This is a common issue in industry and FAA programs designed to promote the greater good of the system by encouraging voluntary reporting of errors and infractions by aviation personnel and operators without threat of disciplinary action or penalty. A CASS, in any event, is concerned specifically with identifying and correcting deficiencies in the inspection and maintenance *programs* and should be designed to that objective, rather than specific event resolution, even if CASS analysts research specific events.

b. Analytical tools and processes. While it is not necessary for an operator to implement any specific externally developed system, analytical tools or processes are available to assist in the analysis process. Examples of these are:

(1) Maintenance Error Decision Aid. Developed by the Boeing Human Factors Engineering group in collaboration with the FAA, airlines, and the International Association of Machinists for analyzing human performance issues related to maintenance errors and trends. Operators use the Maintenance Error Decision Aid to track events, investigate and prevent maintenance errors, and identify contributing factors, corrective actions, and prevention strategies. A software analysis package has been developed to work with this aid and facilitate analysis of systemic issues.

(2) Managing Engineering Safety Health. Developed by the University of Manchester in collaboration with British Airways Engineering. This system is geared toward researching the workplace and organizational environment in aircraft maintenance to find the issues with the greatest potential to contribute to human factors problems. The system uses software, diagnostic, and sampling tools. Managing Engineering Safety Health conducts anonymous survey-like assessments among personnel at the work location, which are then analyzed. (This is a more structured, data-intensive approach toward determining and monitoring personnel attitudes toward the system than the interview process discussed earlier. The industry has far less practical experience with Managing Engineering Safety Health than with the Maintenance Error Decision Aid.)

(3) Human Factors Accident Classification System Maintenance Extension. Developed by the U.S. Naval Safety Center in collaboration with the FAA for use in the air carrier industry as well as naval aviation. This comprehensive system incorporates a number of analytical tools and has profiled maintenance errors and contributing conditions, permitting development of potential prevention measures. While the Human Factors Accident Classification System Maintenance Extension may be more sophisticated than many operators would need, it demonstrates principles and techniques of software-aided analysis that could be applied to a CASS.

c. Corrective action options.

(1) Determining whether or not to proceed with a corrective action. Once the CASS auditors and analysts have identified a problem or deficiency, the operator must determine if a corrective action is warranted and, if so, the details of the corrective action.

(2) CASS procedures regarding determining whether to proceed with a corrective action. CASS procedures should outline:

- How such a determination will be made;
- Who will make the determination; and
- What levels of review, if any, will be performed.

(3) Developing the proposed corrective action. Technical area personnel should have primary responsibility for developing the proposed corrective action, as they would be most familiar with the technical workings of the area in question and would be sensitive to the possibility of creating new problems as a result of the corrective action. CASS procedures should emphasize a team approach. Team members should include the CASS auditors or analysts, technical area personnel in the affected maintenance and inspection disciplines, and perhaps other affected areas such as training or flight operations.

(4) Types of corrective actions. There are several possible types of general corrective actions or responses, depending on the outcome of the risk assessment.

- Prevent recurrence through engineering or system changes designed to eliminate the risk.
- Accept the underlying cause of a trend or discrepancy, but reduce the risk through implementing controls or countermeasures. Examples are training, policy or procedure revisions, or warning devices. Other countermeasures might be modifying or introducing new equipment or technology.
- Accept that under certain conditions a discrepancy may occur, and be prepared to contain or mitigate the results of that situation. A CASS does not necessarily have to implement corrective actions for every apparently negative trend or finding. Analysis of findings or trends may identify problem areas that do not present safety hazards and that the operator is willing to accept, in accordance

with its risk assessment process. For example, the operator might find that a higher than average number of component removals with "no fault found" occurs at a particular location. The operator might determine that the reason for this situation is that the aircraft spends insufficient time on the ground for line maintenance to completely isolate the fault. The operator might prefer to continue the brief turn times and simply switch components. This would be a business decision for the operator to make. However, more comprehensive corrective actions would be mandatory if the CASS detects that the inspection and maintenance programs lack adequate procedures and standards to meet the requirements of part 121 or part 135, as applicable.

d. Written procedures for developing and implementing corrective actions. A CASS should provide written procedures for developing and implementing corrective action based on the operator's organizational structure and the training of its personnel. The procedures should:

(1) Result in a specific corrective action plan that addresses basic questions of:

- Development and proposal of the corrective action;
- Analysis and final approval level of the corrective action, including who is responsible for approval of the corrective action;
- Who will implement the corrective action;
- How the responsible person will implement the corrective action;
- When the corrective action should be completed;
- Who will evaluate the outcome, and how, including identification of data to be collected, awareness of the possibility of unintended consequences, and events that should trigger a response;
- Who will monitor the status of the corrective action, and how; and
- Reporting the status of the corrective action (to whom, with what frequency).

(2) Maintain the appropriate role of auditors in developing responses to findings so that they continue to remain independent from the corrective actions they may subsequently audit.

(3) Distinguish clearly between the technical area personnel's responsibility for developing and implementing corrective actions, and CASS personnel responsibility for producing the findings and analysis and making sure the technical area involved develops and implements appropriate corrective actions.

(4) Designate the position or organization responsible for evaluating and approving proposed corrective actions. The CASS director or other designated manager may appoint a corrective action team to design and propose a corrective action. The team—which typically represents a cross section of the departments involved in audits, operational data collection,

analysis, and production—oversees the implementation of the corrective action. Technical and reliability control boards are most often used in conjunction with FAA-approved reliability programs; however, a similar concept applies to a CASS, even if no FAA-approved reliability program exists.

e. Corrective action risk assessment.

(1) CASS procedures regarding risk assessment. CASS procedures should:

- Specify that personnel will analyze a proposed corrective action carefully before its selection and implementation to ensure corrective action is necessary and will actually fix the problem and not lead to unintended negative consequences.

- Remind both CASS and technical area personnel of the need to consider the impact of the proposed corrective action on other aspects of the operation. This would include other areas of the inspection and maintenance programs, such as manuals. The corrective action may require coordination with other areas, such as flight operations, that might be affected.

(2) Personnel involved in risk assessment. Technical area personnel play the key role in risk assessment, but the process should include the CASS analysts, who will act as resources in support of the technical area managers and bring risk assessment and systems analysis techniques to the process. The auditor and analyst should be qualified (through training or experience) in systems analysis and can contribute to the evaluation of a proposed corrective action by determining if the basic system elements have been considered. However, the technical personnel have the expertise to actually develop and implement the corrective action, and to evaluate it in practical terms. Thus, the corrective action is a result of cooperation between the technical personnel and the CASS personnel.

Personnel working on the proposed corrective actions should ensure they consider issues of a timetable for the corrective action implementation, as well as the safety attributes of authority, responsibility, procedures, controls, process measurement, and interfaces.

f. Corrective action plan.

(1) With the root cause analysis complete, corrective action options identified, and risk assessment performed as appropriate, a final decision can be made on the proposed corrective action plan. The corrective action plan should address all relevant issues, including a timetable for completion of the action, with milestones, if appropriate. The appropriate technical department (and other departments, such as flight operations, if the corrective action goes beyond the inspection and maintenance organizations) should then implement the plan.

(2) The CASS procedures should identify:

- How this plan will be approved and at what level of the company, and

- The parties responsible for implementing, monitoring, and ensuring all affected parties are notified, both within inspection and maintenance and externally, if necessary.

504. Follow-up.

a. Monitoring corrective actions. The CASS procedures should:

(1) Specify how implementation of corrective actions will be monitored and evaluated. This may require the following:

- Follow-up audits of a specific area;
- Regular communication from the affected technical area as to the status of the corrective action; and/or
- Other forms of verification action by the auditors or analysts tracking the implementation.

(2) Identify the person or entity (such as a CASS board) responsible for determining if any changes in the status of a corrective action are acceptable. The CASS auditors or analysts have the duty of ensuring the corrective action has been implemented in accordance with the established timetable or, if not, determining why the timetable has changed.

(3) Include responsibilities and guidelines for:

- Tracking the implementation of corrective actions in accordance with the timeline;
- The role of auditors, managers, management committees, and senior management;
- How automation or computerized systems will be used;
- How risk assessment and/or systems analysis will be used to guard against unintended consequences;
- Measures to evaluate the effect of the corrective action; and
- The affected technical area to communicate the status of the corrective action to the person responsible for monitoring implementation.

b. Getting help from a manufacturer. In some cases, the operator may require data or assistance from a manufacturer in correcting a deficiency detected by the CASS. Manufacturers may not always assign these issues the same priority as the operator does. The operator should offer guidance in its CASS procedures, based on its particular experience, on how CASS and other personnel should address requested assistance or information from manufacturers, and how to proceed in case of unsatisfactory or slow responses. This may include developing a standardized letter citing the need for this information or assistance to satisfy the requirements of

§ 121.373, § 135.431, or other pertinent regulations. It may also include working with the FAA principal inspector to find solutions.

c. Follow-up surveillance plan. CASS procedures should include how to determine the level of follow-up audits for verifying corrective action implementation. For example, based on the risk assessment or complexity of the corrective action, the designated CASS analyst or team may schedule special or more frequent audits. They may also change the data collection process or institute other means of verification. The FAA expects the operator to have a well-designed and logical process to design the follow-up actions.

The information and analysis performed through the closed-loop, continuous cycle of surveillance, investigations, analysis, and corrective action permits the operator to refine its audit and data collection priorities through the risk assessment process.

CHAPTER 6. PERSONNEL WHO PERFORM CASS FUNCTIONS

600. Personnel managing CASS functions.

a. A CASS should include a decisionmaking body at a relatively high management level to oversee or carry out CASS functions. These oversight groups could include:

(1) Technical boards concerned with performance and other technical issues;

(2) Administrative boards that may have broader decisionmaking authority to act on technical recommendations; or

(3) A single board combining both functions.

The key concept is that there be a decisionmaking body at a relatively high management level to monitor the CASS and to make critical decisions in a timely manner. Typically, at a smaller operator, this committee or board may be composed of the president of the company and the directors of maintenance and flight operations. Typically, at a larger operator, participants may be managers from several departments, such as maintenance and engineering, quality assurance, and operations.

b. If the operator uses committees or boards as major decisionmaking bodies for CASS issues, members of these bodies should:

(1) Have an appropriate technical background, and

(2) Be thoroughly familiar with the role and functioning of the CASS, systems analysis, and the evaluation of the root cause analysis and proposed corrective actions submitted for their review.

The operator should consider requiring participants in such committees or boards to receive training or orientation on these issues to ensure they can provide critical evaluation. The membership of such boards and committees as well as the basic operating procedures and records should be described in the CASS document.

601. CASS personnel training and experience.

a. Maintenance. Each operator should determine the precise mix of training and experience needed by the operator's auditors and analysts. In general, auditors and analysts should:

(1) Have sufficient maintenance background applicable to the operator's program to ensure they are familiar with inspection and maintenance procedures, technical documents, and aircraft systems.

(2) Be able to understand and interpret the answers and data they see, as well as evaluate facilities, equipment, and processes they observe. While they are unlikely to have specialized knowledge in all of the areas over which they conduct surveillance, a foundation of technical expertise is important.

b. Surveillance and analysis. Auditors and analysts need training and/or experience in the functions they are responsible for surveilling and analyzing. It is also essential that they have training and/or experience in the following areas:

- Systems analysis;
- Auditing techniques;
- Risk assessment and risk management;
- Root cause analysis; and
- Human factors.

Additionally, operators may seek specialized training in specific quality processes or systems for their CASS personnel, such as:

(1) ISO 9000, a quality system set of standards developed by the International Organization for Standardization that seeks to standardize processes into organized and documented systems.

(2) Six Sigma, which is process-oriented from an intensively data-oriented, statistical approach.

c. Technical. Persons who collect and analyze operational data may require specialized technical backgrounds, such as engineering. This will depend on the complexity of the operational data the operator collects. These personnel may work in the unit conducting an FAA-approved reliability program or in an independent data collection and analysis system.

d. Summary of experience and training for CASS personnel. The operator's CASS document should reflect that the carrier has considered the type of experience and training, both initial and recurrent, appropriate to the auditors and analysts in its operation. Areas to consider include those listed in the table below:

Subject Area	Auditors	Audit Analysts	Operational Data Analysts
Part 121/135 (as applicable); Operations Specifications	Initial and recurrent	Initial and recurrent	Initial and recurrent
Systems Analysis Training	General training in quality standards	General training in quality standards, statistics, and/or widely used industry courses such as ISO 9000	General training in quality standards, statistics, and/or widely used industry courses such as ISO 9000
Audit Training	Initial and recurrent; Coordinating Agencies for Supplier's Evaluation (C.A.S.E.) training, if applicable	Experience or training in conducting and reporting results of audits	Statistical investigation experience or training
Risk Assessment Training	Initial and recurrent	Initial and recurrent	Initial and recurrent
Root Cause Analysis Training, Including Human Factors	Initial and recurrent	Initial and recurrent	Initial and recurrent
Technical Competence	FAA mechanic certificate, engineering, or other maintenance background	FAA mechanic certificate, engineering, or other maintenance background	FAA mechanic certificate, engineering, or other maintenance background
Educational Background	Related education or training may partially fulfill similar qualification requirements set by operator	Related education or training may partially fulfill similar qualification requirements set by operator	Related education or training may partially fulfill similar qualification requirements set by operator

CHAPTER 7. COMMUNICATION BETWEEN CASS PERSONNEL AND OTHER DEPARTMENTS

The procedures for communicating CASS information and results internally to interested parties within the operator and, as applicable, externally (for example, vendors, the FAA) vary depending on factors such as the size and nature of the operation, level of automation, and the CASS procedures themselves. The number and complexity of the standardized communications processes, such as forms or electronic mail messages with standard distribution, should be appropriate to the overall size and scope of the operator's operation and CASS.

700. Communicating specific CASS results and actions.

a. The operator should develop appropriate standard communication processes for all aspects of the CASS to assist in standardizing procedures, including the following:

(1) Audit checklists and results.

(2) Analysis procedures and results.

(3) Records of audit/analysis findings — internal.

(4) Records of audit/analysis findings — external.

(5) Corrective action forms and/or action plans. These forms should address system considerations to ensure there is a clear understanding of when the corrective action will be implemented, who is responsible, and what the impact will be on written procedures.

(6) Information for monitoring and follow-up of corrective action. The processes should also assist in tracking the implementation of corrective actions once underway.

(7) Periodic status reports to senior management and to the FAA.

b. The CASS description should address such issues as the following:

(1) Who is responsible for keeping these standard communication processes up-to-date and available;

(2) Who is responsible for completing the standard communication processes;

(3) Where are communications sent, who must respond, and how are responses tracked; and

(4) How, where, and for how long completed records are retained.

701. Educating personnel on CASS.

A CASS should include procedures and responsibility to create some form of communication between the area responsible for the CASS, other areas of the company, and the FAA. This may

be accomplished through training, newsletters, bulletins, meetings, or other formats determined by the operator. One purpose of such communication is to educate mechanics and other departments that feed information and data into the CASS about why these data are necessary, what is done with the data, and how this process benefits the operation.

702. Communications with personnel outside the CASS.

The FAA expects a good communication system to meet the objectives in this section. Each operator must determine which system is best for its operation.

a. A CASS should provide for regular, structured communications within the CASS structure and between the CASS and any other resources involved in decisionmaking for the operator. Examples of these would include:

(1) Avionics and other shops;

(2) Cabin safety organization;

(3) Engineering department and FAA-approved reliability program organization;

(4) FAA certificate management office or principal inspector;

(5) Flight operations;

(6) Ground operations;

(7) Inspection department;

(8) Internal evaluation program;

(9) Maintenance control;

(10) Maintenance operations;

(11) Manufacturers' technical representatives;

(12) Purchasing;

(13) Quality assurance;

(14) Receiving inspection;

(15) Recordkeeping organization;

(16) Safety program;

(17) Senior management;

(18) Stores department; and

(19) Training departments.

b. The communications mechanisms should include a feedback loop designed to ensure that any changes implemented as a result of corrective actions are functioning as intended and are improving the process. This level of communication may be accomplished through a variety of means, including the following:

(1) Periodic (weekly, monthly, quarterly) statistical and narrative CASS reports on trends, findings, and the status of corrective actions.

(2) Periodic CASS meetings to discuss trends or specific problem areas. Such meetings might be informal but frequent, such as at very small operators where the relevant managers work in close proximity, or more structured and formal, such as at larger operators where specific boards or committees may be designated.

(3) CASS board or committee meetings, including senior management, possibly on a monthly or bimonthly basis. Even if meetings are somewhat informal, minutes should be kept.

c. Typically, operators with programs incorporating statistical performance standards (alert-type programs) develop a periodic (monthly) report, with appropriate data displays, summarizing the previous month's activity. To help evaluate the effectiveness of the total maintenance program, the report should cover all aircraft systems controlled by the FAA-approved reliability program. An operator without an FAA-approved reliability program may find that using a similar report can enhance its CASS.

CHAPTER 8. HOW THE CASS DIFFERS FROM AND RELATES TO OTHER PROGRAMS

800. Summary of other programs.

The operator's description of the CASS should identify other related programs in which the operator participates and explain how CASS relates to those programs and/or differs from them. Experience has shown that certain other programs are potential sources of information for the CASS, while other programs may be integrated into a CASS. Some programs have been mistakenly assumed to be so similar to a CASS that the operator might neglect an important aspect of the CASS. Therefore, the CASS documentation should describe the relationship between the CASS and programs such as the:

a. FAA-approved Reliability Program;

b. Internal Evaluation Program;

c. Safety Program;

d. Voluntary Disclosure Reporting Program;

e. Coordinating Agencies for Supplier's Evaluation;

f. Aviation Safety Action Program; and

g. Aviation Safety Reporting Program.

801. Discussion of individual programs.

a. FAA-approved reliability program. According to AC 120–17, Maintenance Control by Reliability Methods, the concept of reliability control was developed to maintain an acceptable level of reliability and evolved based on FAA and airline efforts to develop more responsive methods of controlling maintenance without sacrificing safety or FAA regulatory responsibility. An FAA-approved reliability program includes systems for data collection and analysis, corrective action, statistical performance standards, data display and reporting, maintenance program adjustments, and process changes. AC 120–17 defines an acceptable level of reliability as maintaining failure rates below a predetermined value. Under the program, the operator may adjust maintenance, inspection, and overhaul intervals up to a specific limit without prior FAA approval.

Typically, larger operators have an FAA-approved reliability program, but the operational data collection and analysis requirements of such a program usually exceed the resources or requirements of smaller and even most medium-sized operators and generally are greater than what would be necessary for those operators' CASS. However, if an operator does have an approved reliability program, this may be incorporated into the CASS as the means of performing operational data collection and analysis to monitor the effectiveness of the inspection and maintenance programs. That operator's CASS procedures should describe how the approved reliability program is integrated into the CASS. An FAA-approved reliability program cannot

substitute for a CASS because the reliability program does not include the broader auditing surveillance and analysis of the full range of elements of the inspection and maintenance programs, nor does it include the complete processes for developing and implementing corrective actions.

This AC is not intended to describe FAA-approved reliability programs. However, CASS operational data collection needs are typically similar to, if less extensive than, those of an approved reliability program. An operator may, within its CASS, establish a program similar to an FAA-approved reliability program for the purpose of collecting and analyzing operational data. In such circumstances, the carrier would not be permitted to adjust its inspection or maintenance program without FAA approval. Additionally, the operator must ensure its operational data collection program meets the needs of its CASS.

It is common to use "reliability," in a generic sense, in reference to dispatch availability of equipment or in relation to equipment failure rates. If an operator's CASS manual or document uses this terminology, it should distinguish whether the reference is to an FAA-approved reliability program or to generic reliability.

b. Internal evaluation program. An internal evaluation program is a voluntary program to provide measurement of an operator's internal processes and procedures to assess whether they are adequate and functioning properly. An internal evaluation program should be independent of all other programs and systems and could be a useful tool to evaluate a CASS, as well as other systems or programs, such as the operator's safety program. An internal evaluation program is a very high-level review to provide information to senior management as to how well critical programs, such as a CASS, are working. It would not be a substitute for a CASS. An internal evaluation program is a broader system evaluation program and is less "audit-oriented" than a CASS, although both use a system evaluation approach. An internal evaluation program poses questions necessary to determine if the operator's systems, such as its CASS, are effective and efficient, and if the current program would support further growth.

AC 120–59, Air Carrier Internal Evaluation Programs, describes the internal evaluation program. The internal evaluation program should not be misunderstood as a program that replaces existing regulatory auditing requirements such as a CASS. Audits are a very minor part of an effective internal evaluation program.

c. Safety program. Certificate holders conducting operations under part 121 are required to have a director of safety or equivalent position unless the FAA permits a deviation in the required management positions according to 14 CFR § 119.65. The director of safety should oversee a function that addresses the range of risks involved in commercial aviation, including flight operations, maintenance, and ground operations. The director of safety should manage a comprehensive safety program with a variety of elements, such as investigations of and a reporting system for accidents and incidents, safety audits and inspections, operational risk assessment, and trend analysis.

Certificate holders conducting operations under part 135 are not required to have a director of safety position. Nevertheless, the FAA encourages these operators to designate a company management official or manager to monitor and evaluate flight, maintenance, and ground safety practices, procedures, and programs.

d. Voluntary Disclosure Reporting Program. AC 00–58, Voluntary Disclosure Reporting Program, provides guidance on procedures for certificate holders to use when voluntarily disclosing to the FAA apparent violations of certain Federal Aviation Regulations. An operator's participation in the program may reveal important information regarding maintenance issues and lead to the development of comprehensive fixes relevant to the inspection and maintenance programs a CASS oversees.

Under this program, the operator may voluntarily report violations of regulations that it discovers and avoid certain enforcement consequences. Some operators may be concerned about discussing regulatory infractions in widely disseminated CASS documents, even if they are addressed through the Voluntary Disclosure Reporting Program.

It is not required that a CASS address disclosures made under the Voluntary Disclosure Reporting Program. However, the FAA recommends that the operator consider, in developing its CASS procedures, whether to attempt to include information from voluntary disclosures in its CASS in any fashion. For example, CASS personnel may be the same personnel as those who handle voluntary disclosures. They may therefore be able to use "de-identified" information from voluntary disclosures to point to areas where additional auditing may be necessary. CASS personnel should be aware of comprehensive fixes developed in conjunction with the Voluntary Disclosure Reporting Program. These are, after all, precisely the types of systems or procedural modifications that an effective CASS is seeking, to avoid adverse audit findings or unwanted operational performance.

e. Coordinating Agencies for Supplier's Evaluation. Coordinating Agencies for Supplier's Evaluation (C.A.S.E.) is a cooperative effort within the airline industry to audit suppliers and vendors and to analyze, control, and determine the acceptability of vendors supplying parts and maintenance services to participating airlines. According to FAA Order 8300.10, Airworthiness Inspector's Handbook, the FAA has determined that use of C.A.S.E. audits can satisfy some of the requirements of §§ 121.373 and 135.431. The use of the C.A.S.E. program to satisfy these requirements must be authorized on operations specifications.

If the operator participates in C.A.S.E., the CASS procedures should address whether or how the CASS will use C.A.S.E. audits and the basis for that decision. If the functions being audited depend on the specifics of the operator's program, a C.A.S.E. audit would probably not suffice. The important point is that the operator have a written policy and procedures for when and how to use C.A.S.E. audit results in its CASS.

f. Aviation Safety Action Programs. AC 120–66, Aviation Safety Action Programs, describes this program for the voluntary reporting of safety issues and events by employees, such as crewmembers and mechanics, of certain certificate holders. Aviation Safety Action Programs involve the collection, analysis, and retention of safety data that would otherwise be unobtainable. Such data can be important input to a CASS.

g. Aviation Safety Reporting Program. AC 00–46, Aviation Safety Reporting Program, describes this program which uses the National Aeronautics and Space Administration (NASA) as a third party to receive aviation safety reports. The Aviation Safety Reporting Program invites crewmembers, maintenance personnel, and others to report to NASA actual or potential discrepancies and deficiencies involving aviation safety. NASA designed and administers the Aviation Safety Reporting System to facilitate the program. These reports may help CASS personnel identify areas of potential concern within their own company based on industry-wide trends or experiences identified by NASA.

CHAPTER 9. HOW TO DETERMINE IF THE CASS IS WORKING PROPERLY

900. Why a CASS should be evaluated.

As with any system or program at the operator, the CASS itself should be evaluated (that is, a process measurement should be accomplished) so that any personnel responsible for overseeing the CASS, such as the operator's top management, may be confident that the CASS is accomplishing its function. Verifying that a CASS is working as intended is also a primary task of the FAA principal inspector.

A common misconception is that an operator can evaluate its CASS based solely on the results of the inspection and maintenance programs. That is, it is common to assume that if the aircraft are consistently airworthy, the CASS must be doing its job. However, this favorable result may occur for other reasons, such as the extraordinary diligence or memory of a few individuals. The purpose of the CASS is to ensure, with a system-oriented, structured approach, that inspection and maintenance programs are properly executed and are effective consistently and by design rather than by luck. The operator should not assume that good maintenance is synonymous with the CASS working properly.

Thus, personnel with CASS oversight responsibilities (including the FAA) require a different approach to determine if the CASS is indeed working properly. They need to know that the operator has complete CASS policies and procedures to monitor and evaluate the inspection and maintenance programs, that these policies and procedures are being carried out, and that they work. For example, to ensure the CASS is functioning properly, a senior operator manager would not analyze component removal rates, but rather verify that the CASS is analyzing component removal rates, detecting trends as appropriate, and implementing corrective actions when necessary. The operator should have procedures, either in the CASS manual or referenced in the CASS manual but contained in another document (such as its internal evaluation program manual), for evaluating the CASS and informing top management of the effectiveness of the CASS, separate from the effectiveness of the inspection and maintenance programs. The regulations not only require inspection and maintenance programs that meet many specific standards, they also separately require a system to monitor those programs.

901. Steps to evaluate the CASS.

The FAA expects an operator to develop its own methods of evaluating whether its CASS is working properly, including how the operator intends to measure whether it has allocated sufficient staffing and resources to its CASS.

a. System safety attributes. Determine that the CASS addresses applicable system safety attributes (responsibility, authority, procedures, controls, process measurement, and interfaces). If the operator has an internal evaluation program that follows this format, it would provide the operator's senior management with an appropriate means of evaluating the CASS. That would be one way, but not the only way, to evaluate a CASS.

b. Indicators. The following questions may be useful in indicating whether the CASS is designed properly or working as intended, although the operator may identify other indicators:

(1) Are CASS personnel sufficiently independent of the areas they audit? Are they trained specifically in their CASS responsibilities?

(2) Are the resources allocated to the CASS sufficient to permit timely analysis of audits and data, as well as follow-up to corrective actions? Or are there delays in responding to findings and implementing corrective actions?

(3) Are CASS personnel able to perform their duties in accordance with reasonable schedules?

(4) How many findings are produced by the CASS, and what are the trends?

NOTE: CASS is supposed to produce findings, so absolute numbers, even high numbers of findings, are not necessarily a negative outcome; if combined with effective corrective actions and follow-up action, numerous CASS findings could be a positive indicator that the CASS is doing its job of detecting deficiencies and yielding appropriate, well-analyzed corrective actions. Trends are important, however. The same types of findings should not recur often once the CASS has addressed them.

(5) Have an unusually large number of unplanned maintenance events occurred within a specified time (for example, 21 days) after a substantial inspection or maintenance task? If so, does an investigation indicate there are deficiencies in the inspection and maintenance programs that should have been averted by the CASS, or can the anomaly be attributed to other factors?

(6) Does analysis indicate recurring problems in areas previously thought to have been addressed by corrective actions?

(7) Are new problem areas coming to light? (This would be indicative of the CASS working to detect new issues.)

(8) Are CASS corrective actions resulting in new problem areas, reflecting insufficient risk or system analysis before the implementation of these corrective actions?

(9) How do CASS results compare with outside audit results, such as those conducted by the DoD or the FAA?

(10) Have regulatory violations occurred that the CASS might have averted?

(11) Does operator senior management understand and support the CASS?

(12) Are CASS auditors and analysts encouraged to consider all possible aspects of an issue, including the role of senior management, when developing corrective actions?

(13) Has the CASS evolved into a punitive process with the result of discouraging open participation of company personnel, or do personnel cooperate actively and offer input to the CASS?

(14) Are all areas of the inspection and maintenance programs undergoing CASS audits in accordance with a schedule based on a process of risk assessment and prioritization?

(15) Do the depth and quality of the audit reports and analysis reflect that personnel have sufficient time and resources?

c. Senior management review. Senior management should review CASS issues on a monthly or bimonthly basis. Meetings of this sort, possibly of CASS or maintenance management committees or boards, may be held to discuss findings, analysis, and the progress of corrective actions. These meetings may address statistical data and trends, depending on the operator's size and operation and their ability to produce comprehensive statistical reports.

CHAPTER 10. THE ROLE OF THE FAA IN RELATION TO AN OPERATOR'S CASS

1000. The FAA's general role.

As with any applicable aviation regulation, an operator must understand that it holds the primary responsibility for compliance, not the FAA. The FAA's role is not to design the CASS for each operator, but to ensure the operator has satisfactory policies and procedures in place. For example, the FAA will not provide the industry with an exhaustive list of data to be collected and analyzed because of the wide variation in the nature and scope of their operations. However, the FAA expects each operator with a CASS to demonstrate that its CASS includes a process for selecting and periodically reevaluating data sets appropriate for its operation and for monitoring the inspection and maintenance programs. The FAA also expects each operator to have a logical and current reason for selecting the data sets it collects.

1001. The FAA principal inspector's role.

The term FAA principal inspector, as used in this AC, is generally intended to mean the principal maintenance inspector (PMI). However, the principal avionics inspector (PAI) also plays an important role in the oversight of the operator's CASS and shares many of the same responsibilities as the principal maintenance inspector (PMI). The FAA principal inspector:

a. Works with the operator in developing the CASS, in providing guidance, and in ensuring the operator's CASS meets the intent of the regulation.

b. Reviews the operator's CASS records, such as results of audits and analysis, corrective action, and follow-up. Therefore, it would be useful for the operator and the principal inspector to have a common understanding of how long the operator will retain these records, not only in terms of usefulness to the CASS but also to help the inspector determine the operator is properly executing its CASS.

c. Meets on a regular basis with managers in the maintenance, inspection, and quality assurance areas, particularly with the person responsible for the CASS. The operator's CASS should provide one of the best barometers of the overall status of the inspection and maintenance programs, how they are being executed, whether they are effective, and whether change is being implemented as necessary.

d. Meets occasionally with senior management to determine how well they understand and support the CASS.

CHAPTER 11. ADMINISTRATIVE INFORMATION

1100. How to obtain FAA publications.

a. AC 00.2, Advisory Circular Checklist, as amended, contains a listing of all ACs. AC 00–44, Status of Federal Aviation Regulations, as amended, contains a listing of the CFR and current prices. You can also obtain a copy of current regulations online at http://www.access.gpo.gov/ecfr/. You can obtain the CFR and ACs, for which there is a fee, from the following address:

Superintendent of Documents
P.O. Box 371954
Pittsburgh, PA 15250-7954

b. To be placed on our mailing list of free ACs, contact:

U.S. Department of Transportation
Subsequent Distribution Office
SVC-121.23
Ardmore East Business Center
3341 Q 75th Avenue
Landover, MD 20785

c. Our Web site is located at http://www.faa.gov.

APPENDIX 1
SAMPLE CASS FOR A LARGE OPERATOR

Type of Operator

Fleet composition	150 turbojet airplanes; B–737, B–757, A–320.
Number of maintenance base and line stations	Base station and 25 line stations.
Proportion of maintenance contracted to third parties	All letter checks, overhauls, and major maintenance performed in-house. Some line maintenance, parts work, and off-wing engine work is contracted.
Scheduled or on-demand	Scheduled (part 121).
Size and structure of inspection and maintenance organizations	Engineering and maintenance organizations include extensive engineering capability, quality assurance department, full range of shops for support, components, electronics, engines, etc.

CASS Management and Planning

General priority
This operator prioritizes in the following manner:

(1) Safe operations (air and ground).

(2) Detect and prevent noncompliance.

(3) Improve operating efficiency.

CASS written procedures (A System Safety Attribute — Procedures)
The CASS written procedures are located in a separate CASS manual. The CASS appendix is detailed, including specific procedures for root cause and systems analysis and discussion of how to address human factors.

CASS in the operator organization
The senior vice president of engineering and maintenance actively supports the CASS. The CASS specifically appears on the functional organizational flowchart.

Authority for CASS (A System Safety Attribute — Authority)
The director of quality assurance holds the authority for the CASS.

Responsibility for CASS (A System Safety Attribute — Responsibility)
The CASS board is responsible for the CASS. The board is chaired by the manager of the CASS, who reports to the director of quality assurance.

Policy for CASS auditor/analyst independence from production (A System Safety Attribute — Controls)
CASS auditors/analysts are in a separate department under quality assurance. Operational data collection and analyses are assigned to the reliability group (within the operator's FAA-approved

reliability program) in the engineering department. The reliability group reports CASS information directly to the CASS board.

Policy regarding personnel actions resulting from CASS findings/results
The operator's policy is consistent with its participation in Aviation Safety Action Programs and the Voluntary Disclosure Reporting Program. Inadvertent errors do not lead to disciplinary action or FAA enforcement action. Full reporting and disclosure is encouraged to facilitate system corrections.

Surveillance and Analysis of *Performance* of Inspection and Maintenance

Audits

Responsibility	Manager of CASS.
Prioritization	CASS board develops a surveillance plan based on risk assessment.
Cycles	Each area is audited semiannually to every 3 years, depending on priority. Annual audit plan is updated quarterly.
Scope	CASS covers all internal and third-party areas of maintenance and inspection. Coordinating agencies for Supplier's Evaluation audits may indicate the need for follow-up audits or may be integrated into the CASS.
Process	Full-time CASS auditors use checklists and conduct annual interviews of personnel at all levels of maintenance and inspection to uncover concerns or latent problems. The CASS department receives reports of all maintenance-related events, such as rejected takeoffs, for analysis and use in risk assessment for audits. Special audits may be scheduled as needed. The CASS also reviews self-audits from all departments. Some vendor audits are conducted by document reviews, written questionnaires, telephone follow-up, or combinations of these. Follow-up is required if preliminary results raise concerns.
Flow	Initial results are reported to the manager of the CASS. The CASS board reviews summaries of all findings/initial analyses and details of issues as deemed necessary by the manager of CASS.

Analysis

Responsibility	Auditors conduct preliminary analysis based on specific experience and training and internally developed guidelines that channel analysis to system root causes.
Perform preliminary root cause analysis	Auditor/analyst.
Classify hazards/ perform risk assessment	CASS board and analysts.
Flow	The CASS board transmits results to the affected department, which assigns personnel to participate on the corrective action team under direction of the CASS board.

Surveillance and Analysis of *Effectiveness* of Inspection and Maintenance

Operational data collection

Responsibility	Manager of CASS.
Prioritization	The reliability group determines priority based on risk assessment.
Scope	Extensive. Ranges from pilot reports, engine condition monitoring, mechanical delays, and teardown reports to data from special authorizations such as Category II/III, extended range operation with two-engine airplanes, and operations in reduced vertical separation minimum airspace and minimum navigation performance specifications airspace.
Process	In accordance with the operator's FAA-approved reliability program. Data collection is oriented toward detecting trends, positive or negative, before occurrence of events. However, data collection (and analysis) may vary based on maintenance-related events. The list of operational data sets collected is formally reviewed by the CASS board every two years to determine if it needs to be adjusted. The initial list is based on AC 120–17 and CASS board determinations.
Flow	The reliability group, although located within the engineering department, has a direct reporting relationship to the manager of CASS.

Analysis of operational data

Responsibility	Reliability group.
Prioritization	Reliability board.
Process	Technical experts within the reliability group perform the analysis and make preliminary determination of possible root causes.
Flow	Results are reported to the manager of the CASS and the CASS board.

Corrective Action

Final root cause analysis

Responsibility	Manager(s) of technical area(s) affected.
Procedures	The director of CASS transmits preliminary analysis results to the manager of the affected department, who designates technical personnel to coordinate final root cause analysis with the auditor/analyst. CASS auditor/analyst oversees the process and ensures the formal root cause analysis process, including human factors and systems analysis, is followed.
Use of specific analytical systems	Internally developed analytical process and industry tools.
Flow	The auditor/analyst and technical department develop a joint final report and submit it to their respective managers.

Determination of corrective action options

Responsibility	The CASS board appoints a corrective action team, to include the CASS auditor/analyst, reliability group, technical area(s) affected, and related areas potentially affected (for example, flight operations).
Procedures	The team leader is from the technical area affected. Perform risk assessment of the problem and develop corrective action options. The CASS auditor/analyst or reliability group representative does not propose corrective actions but reviews options for systems considerations and relevance to root cause analysis.
Flow	The manager(s) of the affected area(s), working with the team, transmits options to the CASS board.

Selection of corrective action and corrective action plan

Responsibility	CASS board.
Procedures	Decision based on a priority for safety and regulatory compliance. Risk assessment is the basic tool to support the decision. CASS personnel do not participate in development of the corrective action but review for systems considerations and relevance to root cause analysis.
Flow	Depends on the level of the problem and the corrective action. Routine issues may be resolved at the team level with direct implementation by the affected area manager; the CASS board is then advised of this action. More significant program changes may require prior review and concurrence from the CASS board. Highest-level decisions may be raised by the CASS board to the director of quality assurance or the senior vice president of engineering and maintenance.

Follow-up

Responsibility	Manager of CASS.
Procedures	CASS auditor/analyst or reliability group, as applicable, assigned to develop follow-up plan based on seriousness of the problem. Follow-up may include communications from technical area verifying implementation, follow-up audits or data collection, and/or follow-up evaluation.
Flow	Technical area reports implementation status to manager of the CASS, who informs the CASS board. The CASS board may inform the director of quality assurance if problem is sufficiently serious or implementation plan is not followed.

NOTE: The above provide many examples of the system safety attributes — controls and procedures.

Communications Between CASS and Other Personnel (A System Safety Attribute — Interfaces)

Communication of specific CASS results and actions

Responsibility	CASS board.
Procedures	Audits based on updated checklists. Operational data are collected and stored in computer systems; some analysis and alerting features are automated. Audit and analysis results communicated through company electronic mail system, with acknowledgements. Corrective action tracking through computerized database system.
Flow	Electronic mail and standard electronic reports of information flow among CASS board, corrective action teams, technical areas, and director of quality assurance, when applicable.

Communications with inspection and maintenance personnel

Responsibility	CASS board.
Procedures	CASS initial and recurrent training included for all personnel, including lectures from CASS personnel. Monthly newsletter summary to production areas regarding CASS activities.
Flow	CASS department works with training and company communications department, and receives feedback from managers and supervisors, particularly in the maintenance and inspection areas.

Interfaces (A System Safety Attribute — Interfaces)

Responsibility: CASS board.
Flow: Communications channeled through manager of the CASS.
Procedures:

TO CASS Board	FROM CASS Board
Reliability group provides regular reports on analyses results, trends, and concerns.	Feedback to technical areas regarding findings, trends, concerns, and follow-up results.
Auditors/analysts provide regular reports on findings, analyses, trends, and concerns.	Feedback to Voluntary Disclosure Reporting Program manager regarding proposed comprehensive fixes; coordination with manager of the CASS.
Voluntary Disclosure Reporting Program manager provides summaries of disclosures and proposed comprehensive fixes for CASS review and input.	Monthly reliability analysis summaries and other CASS summaries for distribution to the vice president of engineering and maintenance; director of quality assurance and other senior management; department managers in maintenance, inspection, flight, and ground operations; internal evaluation program; safety office; and FAA principal inspector.

TO CASS Board	FROM CASS Board
Copies of Coordinating Agencies for Supplier's Evaluation audit results.	CASS reports reflect Voluntary Disclosure Reporting Program comprehensive fixes without detailing the initiating circumstances.
CASS auditors review reports from company Aviation Safety Action Programs and at least annually review maintenance-related Aviation Safety Reporting Program reports for consideration in setting audit and operational data collection priorities.	Semiannual summary report to chief executive officer.
	Copies of reliability reports and CASS summaries to FAA principal inspector. The FAA principal inspector has online access to CASS reports and documents such as summaries, analyses, trends, and corrective action tracking.
	CASS board meeting minutes.

Personnel Who Perform CASS Functions

Full-time auditors and analysts; in some cases, an auditor may also be an analyst.

All members of the CASS board who have not participated in specific CASS training receive a total of 16 hours initial training covering CASS, root cause and systems analysis, and human factors.

Company has hired a human factors specialist to address issues across all departments and to participate on the CASS board.

How the Operator Evaluates Its CASS (A System Safety Attribute — Process Measurement)

Responsibility	Senior vice president of engineering and maintenance.
Procedures	Internal evaluation program evaluates CASS annually.
Flow	Internal evaluation program reports on CASS are transmitted directly to the chief executive officer and to the senior vice president of engineering and maintenance.

APPENDIX 2
SAMPLE CASS FOR A MEDIUM OPERATOR

Type of Operator

Fleet composition	75 turboprop and turbojet airplanes; ATR–42, Canadair Regional Jets.
Number of maintenance base and line stations	Base station and 5 line stations.
Proportion of maintenance contracted to third parties	A, B, and C checks and most major inspections and maintenance in-house. Off-wing engine maintenance, avionics, and instrument overhauls contracted.
Scheduled or on-demand	Scheduled (part 121).
Size and structure of inspection and maintenance organizations	Engineering and maintenance organizations include small engineering capability, shops for support, components, electronics, engines, etc., and quality assurance department.

CASS Management and Planning

General priority
This operator prioritizes in the following manner:

(1) Safe operations (air and ground).

(2) Detect and prevent noncompliance.

(3) Improve operating efficiency.

CASS written procedures (A System Safety Attribute — Procedures)
The CASS is described in an appendix to the general maintenance manual. The CASS appendix is detailed, including specific procedures for root cause and systems analyses, and discussion of awareness of human factors.

CASS in the operator organization
The chief executive officer supports the CASS. CASS specifically appears on the functional organizational flowchart.

Authority for CASS (A System Safety Attribute — Authority)
Vice president of engineering and maintenance.

Responsibility for CASS (A System Safety Attribute — Responsibility)
The director of quality assurance heads the CASS board, which includes key department heads in engineering and maintenance, training, and flight operations.

Policy for CASS auditor/analyst independence from production (A System Safety Attribute — Controls)
CASS auditor/analysts are in a separate department under quality assurance. Operational data collection and analyses assigned to a "CASS reliability group" that is contained within the

engineering department but is not an approved reliability program and is unable to implement changes in the maintenance and inspection intervals without prior FAA approval. The CASS documentation is explicit that the operator's reliability program is not FAA-approved. The reliability group reports CASS information directly to the director of quality assurance.

Policy regarding personnel actions resulting from CASS findings/results
Inadvertent errors will not lead to disciplinary action. Full reporting and disclosure is encouraged to facilitate system corrections. Operator participates in FAA Voluntary Disclosure Reporting Program.

Surveillance and Analysis of *Performance* of Inspection and Maintenance

Audits

Responsibility	Director of quality assurance.
Prioritization	CASS board develops audit plan based on risk assessment.
Cycles	Audit plan is established and reviewed annually. Audits are completed semiannually to biannually, depending on prioritization.
Scope	All internal and third-party areas of maintenance and inspection.
Process	CASS board developed audit checklists for use by auditors. Audits are conducted in accordance with the annual plan. CASS department receives reports of all maintenance-related events, such as rejected takeoffs, for analysis and use in risk assessment for audits. Special audits may be scheduled as needed. Some vendor audits are conducted by document reviews, written questionnaires, telephone follow-up, or combinations of these. Follow-up is required if preliminary results raise concerns.
Flow	Initial reports and summaries to director of quality assurance.

Analysis

Responsibility	Director of quality assurance.
Perform preliminary root cause analysis	Auditor/analyst.
Classify hazards/ perform risk assessment	The CASS board and analysts classify hazards and perform risk assessment.
Flow	Director of quality assurance reports summaries of all findings/initial analyses and details of issues to the CASS board for review and concurrence. CASS board transmits results to affected department, which forms corrective action team.

Surveillance and Analysis of *Effectiveness* of Inspection and Maintenance

Operational data collection

Responsibility	Director of quality assurance.
Prioritization	Reliability group.
Scope	Includes pilot reports, engine condition monitoring, mechanical delays, teardown reports, and other data.
Process	Modeled after FAA-approved reliability programs. Data collection oriented toward detecting trends, positive or negative, before occurrence of events. However, data collection (and analysis) may vary based on maintenance-related events. Operational data sets collected formally reviewed by CASS board every 2 years; initial list based on AC 120–17, and CASS board determinations.
Flow	Reliability group, although located within the engineering department, has a direct reporting relationship to the director of quality assurance.

Analysis of operational data

Responsibility	Director of quality assurance.
Prioritization	Reliability group.
Process	Analysis performed by technical experts within the reliability group; includes preliminary determination of possible root causes or possible procedural changes.
Flow	Results are reported to CASS board.

Corrective Action

Final root cause analysis

Responsibility	Director of quality assurance.
Procedures	CASS board transmits preliminary analysis results to the manager(s) of the affected department(s), who designates technical personnel to conduct final root cause analysis with the CASS auditor/analyst. The CASS analyst oversees the process and ensures the root cause analysis process, including human factors and systems analyses, is followed.
Use of specific analytical systems	Internally developed formal analysis process or common industry tools.
Flow	Technical department develops final report and submits it to the director of quality assurance.

Determination of corrective action options

Responsibility	Director of quality assurance designates corrective action team, led by primary affected technical department(s), whose manager(s) designates a team leader.
Procedures	Risk assessment of the problem and the options. The CASS auditor/analyst or reliability group representative does not propose corrective actions but reviews possibilities for systems considerations and relevance to root cause analysis.
Flow	Team presents recommendation to CASS board.

Selection of corrective action and corrective action plan

Responsibility	Director of quality assurance.
Procedures	Decision based on a priority for safety and regulatory compliance. Risk assessment is the basic tool to support the decision. CASS board verifies systems considerations and relevance to root cause analysis.
Flow	Depends on the level of the problem and the corrective action. Routine issues may be resolved at the team level with direct implementation by the affected area manager; the CASS board is then advised of this action. More significant program changes may require prior review and concurrence from the CASS board or elevation to vice president of engineering and maintenance.

Follow-up

Responsibility	CASS board.
Procedures	CASS auditor/analyst or reliability group, as applicable, assigned to develop follow-up plan based on seriousness of the problem. Follow-up may include communications from technical area verifying implementation, follow-up audits or data collection, and/or follow-up evaluation.
Flow	Technical area manager reports to director of quality assurance, who reports to CASS board.

NOTE: The above provide many examples of the system safety attributes — controls and procedures.

Communications Between CASS and Other Personnel (A System Safety Attribute — Interfaces)

Communication of specific CASS results and actions

Responsibility	CASS board.
Procedures	Audits based on updated checklists. Operational data are collected and stored in computerized database systems; some analysis and alerting features are automated. Audit and analysis results communicated through paper forms. Corrective action tracking through computerized database system.
Flow	Through electronic mail communications and standard paper reports, information flows among CASS board, corrective action teams, technical areas, and the director of quality assurance.

Communications with inspection and maintenance personnel

Responsibility	CASS board.
Procedures	CASS training included for all personnel; initial and recurrent training. The operator's employee newsletter includes a brief monthly report on CASS results.
Flow	CASS board works with training and company communications department and receives feedback from managers and supervisors, particularly in the maintenance and inspection areas.

Interfaces (A System Safety Attribute — Interfaces)

Responsibility: CASS board.
Flow: Communications channeled through director of quality assurance.
Procedures:

TO CASS Board	FROM CASS Board
Reliability group provides regular reports on analyses results, trends, and concerns regarding operational data.	Feedback to technical areas regarding findings, trends, concerns, and follow-up results.
Auditors/analysts provide regular reports on findings, analyses, trends, and concerns.	Feedback to Voluntary Disclosure Reporting Program manager regarding proposed comprehensive fixes; coordination with director of quality assurance.
Voluntary Disclosure Reporting Program manager provides summaries of disclosures and proposed comprehensive fixes for CASS review and input.	Monthly reliability analyses summaries and CASS summaries for distribution to vice president of engineering and maintenance, director of quality assurance, and other senior management; department managers in maintenance, inspection, flight, and ground operations; internal evaluation program; safety office; and FAA principal inspector.
Designated CASS auditor/analyst reviews reports and at least annually reviews maintenance-related Aviation Safety Reporting Program reports for consideration in setting audit and operational data collection priorities.	CASS reports reflect Voluntary Disclosure Reporting Program comprehensive fixes without detailing the initiating circumstances.
	Copies of reliability reports and CASS summaries to FAA principal inspector.
	CASS board meeting minutes.
	Semiannual summary report to chief executive officer; copy to FAA principal inspector.

Personnel Who Perform CASS Functions

Full-time auditors and analysts; in some cases, an auditor may also be an analyst.

All members of the CASS board who have not participated in specific CASS training receive a total of 12 hours initial training covering the CASS, root cause and systems analyses, and human factors.

How the Operator Evaluates Its CASS (A System Safety Attribute — Process Measurement)

Responsibility	Vice president of engineering and maintenance.
Procedures	Internal evaluation program evaluates CASS annually.
Flow	Internal evaluation program reports on CASS are transmitted directly to the chief executive officer and to the vice president of engineering and maintenance.

APPENDIX 3
SAMPLE CASS FOR A SMALL OPERATOR

Type of Operator

Fleet composition	Two turboprop airplanes; Saab 340B.
Number of maintenance base and line stations	Base station only.
Proportion of maintenance contracted to third parties	A checks in-house; B, C, and D checks, all off-wing engine maintenance, and all overhauls of engines, instruments, and avionics contracted out.
Scheduled or on-demand	On-demand (part 135).
Size and structure of inspection and maintenance organizations	Maintenance structure comprises director of maintenance with chief inspector.

CASS Management and Planning

General priority
This operator prioritizes in the following manner:

(1) Safe operations (air and ground).

(2) Detect and prevent noncompliance.

(3) Improve operating efficiency.

CASS written procedures (A System Safety Attribute — Procedures)
CASS chapter in general maintenance manual. The CASS chapter includes specific procedures for root cause and systems analyses, and discussion of awareness of human factors.

CASS in the operator organization
Chief executive officer actively participates in the CASS. CASS specifically appears on functional organizational flowchart.

Authority for CASS (A System Safety Attribute — Authority)
Chief executive officer.

Responsibility for CASS (A System Safety Attribute — Responsibility)
Director of maintenance heads CASS committee, which includes the chief executive officer, chief inspector, and director of flight operations.

Policy for CASS auditor/analyst independence from production (A System Safety Attribute — Controls)
Director of maintenance "borrows" auditors within or outside the company based on auditor qualifications. Priorities are (1) independent from audited department and (2) experience or familiarity with the area to be audited. Every 5 years the company contracts an independent firm to conduct an outside evaluation of the CASS and other operator systems and programs to verify sufficient objectivity in the audits.

Policy regarding personnel actions resulting from CASS findings/results
Inadvertent errors will not lead to disciplinary action. Full reporting and disclosure encouraged to facilitate system corrections.

Surveillance and Analysis of *Performance* of Inspection and Maintenance

Audits

Responsibility	Director of maintenance.
Prioritization	CASS committee assigns priorities based on risk assessment.
Cycles	Audit plan is established and audits are accomplished annually.
Scope	All internal and third-party areas of inspection and maintenance.
Process	CASS committee developed audit checklists for use by auditors, who may be committee members or personnel drawn from throughout the company. Director of maintenance receives reports of all maintenance-related events, such as rejected takeoffs, for analysis and use in risk assessment for audits. Special audits may be scheduled as needed. Vendor audits are conducted by document reviews, written questionnaires, telephone follow-up, or combinations of these. Follow-up is required if preliminary results raise concerns.
Flow	Initial results are reported to the director of maintenance.

Analysis

Responsibility	Director of maintenance (conducts preliminary analysis with the auditor).
Perform preliminary root cause analysis	Auditor/analyst.
Classify hazards/ perform risk assessment	CASS committee.
Flow	CASS committee reviews all findings/initial analysis and details of issues as deemed necessary by the director of maintenance. The CASS committee acts as the core corrective action team (may be supplemented with other personnel as required).

Surveillance and Analysis of *Effectiveness* of Inspection and Maintenance

Operational data collection

Responsibility	Director of maintenance.
Prioritization	Director of maintenance.
Scope	Basic. Includes pilot reports, engine condition monitoring, mechanical delays, cancellations, teardown reports, and other data.
Process	Data collection oriented toward detecting trends, positive or negative, before occurrence of events. The list of operational data sets collected is formally reviewed by the CASS committee every 2 years to determine if it needs to be adjusted. The initial list is based on the CASS committee's experience at other operations and with this fleet.
Flow	Flight operations and director of maintenance transmit reports to CASS committee.

Analysis of operational data

Responsibility	Director of maintenance.
Prioritization	CASS committee.
Process	Analysis performed by director of maintenance or chief inspector. Preliminary determination of possible root causes or possible procedural changes.
Flow	Results are reported to the CASS committee.

Corrective Action

Final root cause analysis and determination of corrective action options

Responsibility	Director of maintenance.
Procedures	Designates technical personnel to perform final root cause analysis and identify corrective action options. Director of maintenance oversees the process and ensures the root cause analysis process, including human factors and systems analysis, is followed.
Use of specific analytical systems	Based on director of maintenance's training and internally developed procedures.
Flow	Director of maintenance presents corrective action options to the CASS committee.

Selection of corrective action and corrective action plan

Responsibility	CASS committee.
Procedures	Decision based on a priority for safety and regulatory compliance. Risk assessment is the basic tool to support the decision. The CASS committee verifies systems considerations and relevance to root cause analysis.
Flow	CASS committee makes selection.

Follow-up

Responsibility	CASS committee.
Procedures	Affected technical personnel report to the CASS committee on implementation of corrective action. Director of maintenance may independently verify. Follow-up audit planned for following year cycle of audits.
Flow	Technical area reports to director of maintenance, who informs the CASS committee.

NOTE: The above tables provide many examples of the system safety attributes — controls and procedures.

Communications Between CASS and Other Personnel (A System Safety Attribute — Interfaces)

Communication of specific CASS results and actions

Responsibility	CASS committee.
Procedures	Audits based on updated checklists. Operational data are collected and stored in files. Audit and analyses results communicated through electronic mail.
Flow	Electronic mail communications to all company management.

Communications with inspection and maintenance personnel

Responsibility	CASS committee.
Procedures	Director of maintenance conducts initial briefing for all personnel to orient them on CASS.
Flow	Director of maintenance to all affected personnel.

Interfaces (A System Safety Attribute — Interfaces)

Responsibility: CASS committee.
Flow: Communications channeled through director of maintenance.
Procedures:

TO CASS Committee
Director of maintenance provides regular reports on analyses results, trends, and concerns regarding operational data.
Chief inspector reviews reports at least annually and reviews maintenance-related Aviation Safety Reporting Program reports for consideration in setting audit and operational data collection priorities.

FROM CASS Committee:
Feedback to technical areas regarding findings, trends, concerns, and follow-up results.
CASS committee meeting minutes.

Personnel Who Perform CASS Functions

Auditors and analysts are only part-time in these functions. They receive some specific CASS training, including on-the-job and formal training.

How the Operator Evaluates Its CASS (A System Safety Attribute — Process Measurement)

Responsibility	Chief executive officer.
Procedures	Chief executive officer reviews indicators of a properly designed and functioning CASS, including quality of analysis, independence of the audits, and sufficiency of third-party audit procedures.
Flow	The chief executive officer's review is documented and shared with CASS committee members and the FAA principal inspector.

APPENDIX 4
CASS MANUAL/DOCUMENT SAMPLE CONTENTS

A. General Information.

(1) Definition of terms.

(2) Purpose of the CASS.

B. System Organization and Personnel.

(1) CASS organizational chart.

(2) Person/position with authority, including how to determine whether a CASS is functioning properly and policies/procedures for modifying the CASS.

(3) Person/position with responsibility.

(4) Duties and responsibilities of CASS personnel (supervisors, auditors, analysts).

C. Elements Basic to a CASS.

(1) Policies/procedures for scheduling and conducting internal/external audits.

(2) Policies/procedures for identifying and updating the list of operational data sets to be collected, and for collecting data.

(3) Policies/procedures for analyzing audit results.

(4) Policies/procedures for analyzing operational data.

(5) Policies/procedures for developing and analyzing proposed corrective actions.

(6) Policies/procedures for approving and implementing corrective actions, including changes to the maintenance and inspection programs.

(7) Policies/procedures for monitoring and follow-up of corrective actions.

D. Critical CASS Interfaces.

(1) Policies/procedures for communications within the CASS and between the CASS and other areas of the operation.

(2) Interface documents (audit forms and checklists, corrective action notices, statistical and periodic reports, etc., including, as applicable, control, storage, and retrieval of CASS records and communications).

E. Relationship of the CASS to Other Programs.

Policies/procedures to integrate or relate other operator programs to the CASS.

F. Personnel Qualifications.

(1) Policies/procedures regarding qualifications and training of CASS personnel.

(2) Training records.

APPENDIX 5
INFORMATION RELATED TO THIS AC

Related FAA Documents

AC 00-46, Aviation Safety Reporting Program.

AC 00–58, Voluntary Disclosure Reporting Program.

AC 120–16D, Air Carrier Maintenance Programs.

AC 120–17, Maintenance Control by Reliability Methods.

AC 120–59, Air Carrier Internal Evaluation Programs.

AC 120-66, Aviation Safety Action Programs (ASAP).

AC 120–72, Maintenance Resource Management Training.

AC 129–4, Maintenance Programs for U.S.-Registered Aircraft Under FAR Part 129.

FAA Order 8040.4, Safety Risk Management.

FAA Order 8300.10, Airworthiness Inspector's Handbook, volume 2, chapter 65, and volume 3, chapter 37.

FAA Order 8400.10, Air Transportation Operations Inspector's Handbook, appendix 6, chapter 10, figure 10-5.

Flight Standards Handbook Bulletin for Airworthiness (HBAW) 95-06, Maintenance Programs for Aircraft Engines, Including Leased Engines, Used by Operators of Transport Category Aircraft.

HBAW 96-05, Air Carrier Operations Specifications Authorization to Make Arrangements with Other Organizations to Perform Substantial Maintenance.

Joint Flight Standards Handbook for Air Transportation (HBAT) 99-19 and HBAW 99-16, 14 CFR Part 121 and 135 Air Carrier Safety Departments, Programs, and the Director of Safety.

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A Practical Approach to: Conducting a Cost-Effective Root Cause Analysis. Medical Risk Management Associates, LLC. (See http://www.rootcauseanalyst.com/costeffective.htm).

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System Safety Process Steps. (See http://www.asy.faa.gov/Risk/SSProcess/SSProcess.htm).

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