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16. Abstract

A core mission of the Federal Aviation Administration is safety oversight—the process of ensuring that airmen, airlines, aircraft, manufacturers, and a host of others who are engaged in aviation perform their functions safety and responsibly. This report surveys the history of aviation safety oversight in the United States and how decision makers and stakeholders have perceived its performance over time. This report takes a generally chronological approach, dividing the history into seven main epochs.

The effort was motivated by the premise that present efforts to re-engineer the oversight system, to be effectual, required understanding and respect for the how the present system evolved. The performance goals of the present oversight system, and the measures by which goal attainment is assessed, are embedded in this history.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ACRONYMS

AB	Aeronautics Branch
ACA	Air Commerce Act
AD	Airworthiness Directive
ADA	Airline Deregulation Act
AFS	Aviation Flight Standards Service
ALPA	Airline Pilot's Association
AOPA	Airline Owners and Pilots Associations
ASAS	Aviation Safety Analysis System
ATOS	Air Transportation Oversight System
BAC	Bureau of Air Commerce
CAA	Civil Aeronautics Authority
CAB	Civil Aeronautics Board
CASS	Continuing Analysis and Surveillance System
CMT	Certificate management team
CPTP	Civilian Pilot Training Program
CSET	Certification Standardization and Evaluation Team
DOT	Department of Transportation
FAA	Federal Aviation Administration
FEIA	Flight Engineers International Association
FSDO	Flight Standards District Office
GAO	General Accounting Office (since July 2004, Government Accountability Office)
GPWS	Ground Proximity Warning System
IG	Inspector General
ISP	Improved Surveillance Process
NASIP	National Aviation Safety Inspection Program
NATI	National Air Transportation Inspection
NPG	National Work Program Guidelines
NTSB	National Transportation Safety Board
OSHA	Occupational Safety and Health Administration
OST	Office of the Secretary of Transportation
PASS	Professional Airways Systems Specialists
RBO	Regulation by Objective
SAFE	Safety Activity Functional Evaluation
SAFER	Special Aviation Fire and Explosion Reduction
SIP	Surveillance Improvement Process
SPAS	Safety Performance Analysis System
SSIP	Supplemental Structural Improvement Program
TSO	Technical Standard Order

EXECUTIVE SUMMARY

One of the Federal Aviation Administration's (FAA) core missions is safety oversight—the process of ensuring that airmen, airlines, aircraft, manufactures, and a host of others who are engaged in aviation perform their functions safely and responsibly. Efforts are currently underway to create a new oversight system, and part of that effort includes a study of how to assess the performance of such a system. Toward that end, this report surveys the history of aviation safety oversight in the United States and how decisions makers and stakeholders have perceived its performance over time. This report takes a generally chronological approach, dividing the history into seven main epochs.

From the beginning, promotion and protection have both been parts of the mission of safety oversight. The relation of these missions is largely complementary. By creating an aviation system that the public trusts and is willing to use, both the promotion and the protection goals are realized.

As the aviation system has matured, it has become harder to assess how oversight affects safety outcomes. Declining accident rates were initially an important indicator. Later accident investigation results yielded important insights. However, the admission that "we regulate by counting tombstones" prompted the search for a better approach.

Cost control has been a long-standing performance goal. On the one hand, federal overseers have generally sought to maintain the support of industry by avoiding requirements involving high disruption or excessive cost. On the other, it has relied on industry to provide much of the front line oversight, beginning with the designee programs of the 1940s. This approach makes the oversight system highly dependent on industry, re-enforcing the need to work cooperatively with industry, rather than as an adversarial rule enforcer, whenever possible.

The evolution of the oversight system can be partially understood in terms of two-long term trends: greater capability to monitor what inspectors do and decreasing ability to observe the safety outcomes that result. In the scheme of James Q. Wilson, this implies that the safety oversight has evolved from a "coping" activity to a "procedural" one, from something akin to a policeman walking his beat to one more similar to the Occupational Safety and Health Administration. The development and enhancement of FAA surveillance programs, i.e., National Program Guidelines and Air Transportation Oversight System reflect this shift, as system managers assert more control over what inspectors do and how they do it. Some believe that with modern risk assessment techniques the system can evolve into a production organization, like the U.S. Post Office or the Social Security Administration. Time will tell whether such a vision can be realized.

1. INTRODUCTION.

One of the Federal Aviation Administration's (FAA) core missions is safety oversight. As used here, the term safety oversight refers to the process of ensuring that airmen, airlines, aircraft, manufacturers, and others who are engaged in aviation perform their functions safely and responsibly. The safety oversight system is rule-based. The FAA sets rules that it believes, if followed, will lead to an acceptable (and very high) level of safety. The FAA also surveils the system to see if the rules are being followed and undertakes enforcements actions—formal and informal—when it finds violations.

Efforts are underway to develop a new system, and a part of that effort is a study of how to assess the performance of a safety oversight system. This report surveys the history of safety oversight in the United States (U.S.) aviation system. The goal was to trace the evolution of the safety oversight system and how decision makers and stakeholders have perceived its performance. The effort was motivated by the premise that present efforts to re-engineer the oversight system, to be effectual, required understanding and respect for how the present system got to where it is. One needs to know the developmental pathway that oversight has followed and past efforts to alter that trajectory. The performance goals of the present oversight system, and the measures by which goal attainment is assessed, are embedded in this history. To move forward, the baseline must be understood.

The sections that follow summarize the history of the safety oversight system in a roughly chronological fashion. The organization is rather unstructured, attempting to capture how one thing led to the next, in terms of both the oversight system itself and the thinking of policy makers and stakeholders about the performance of that system. A brief final section ties together key themes and ideas about the nature of the safety oversight system and key aspects of its performance.

1.1 THE ADVENT OF AVIATION SAFETY OVERSIGHT.

The federal role in aviation safety began not as an industry regulator, but rather as the operator of the U.S. Air Mail Service. Beginning in 1918, the Air Mail Service served a progressively larger route system, culminating with the inauguration of 24-hour service on the transcontinental route between New York and San Francisco in 1924 [1]. The service used government-owned planes, flown by government-employed pilots, and in a marked contrast to the norms of the day, placed a strong emphasis on safety. Elements of the safety program included strict criteria for selecting pilots and requiring regular medical exams for them, careful aircraft inspections, the use of a 180-item checklist at the end of virtually every trip, and regular engine and aircraft overhauls every 100 and 750 hours, respectively. The activity absorbed tremendous manpower: the ratio of mechanics to aircraft was nearly four to one, and 94 percent of airmail service employees were ground personnel [2]. The safety benefits were obvious: the fatality rate for the Air Mail Service was one per 789,000 miles flown between 1922-1925, while the comparable figure for itinerant commercial fliers (for 1924 only) was one per 13,500 [3].

The level of safety attained by the Air Mail Service was one of many factors that led aviation industry leaders to call for the federal government to provide safety oversight. Unlike other cases of federal intervention, aviation safety oversight was a response to the pleas of the

overseen rather than their misconduct. As Herbert Hoover wrote in 1921, "It is interesting to note that this is the only industry that favors having itself regulated by government." [4] The reasons for this wish ranged from the public-minded to the self-interested. Statistics like those cited above, as well as direct experience with the reality they represented, supported the claims that the public "is likely to suffer from badly engineered, badly built or badly repaired aircraft" and that "a great many fatal accidents are daily occurring to people carried in airplanes by inexperienced pilots using aircraft that have not been inspected." [5] While unfortunate in themselves, these large social costs also handicapped the development of the industry by suppressing demand and elevating insurance costs. Finally, industry representatives argued that before "anyone would think of investing any substantial amount of money in the air business he must first have some basic law" defining rights of the aviator and the man on the ground, and regulating who may fly what where, that only federal regulation could provide [6].

These calls were not enough to bring prompt legislative action. During the early 1920s, the aviation sector was too small to attract the level of congressional attention necessary to pass a bill. In 1925, however, Congress passed the Kelley Air Mail Act mandating the U.S. Post Office to turn responsibility for carrying airmail over to private contractors. This made federal air regulation a virtual necessity, and in 1926, Congress passed the original Air Commerce Act (ACA). The ACA established an Aeronautics Branch (AB) in the Department of Commerce. The AB was responsible for licensing and ensuring the airworthiness of all aircraft engaged in interstate commerce, certifying airmen similarly engaged, and developing and enforcing air traffic rules. Within the AB, safety oversight activities were carried out by the Air Regulations Division, which included six sections: inspection, licensing, medical, engineering, statistical, and enforcement [7].

Because the main impetus for the ACA came from the aviation industry, those in charge of implementing the bill viewed its purpose as "not so much to regulate as to promote." [8] The legislation left it to the AB to devise the detailed rules regarding airworthiness and certification, and these were developed with extensive consultation with aviation business leaders. The aim was to improve safety but to avoid placing an excessive burden on the industry. Government cost containment was also an important objective: the Coolidge administration, among the most parsimonious in American history, featured an annual presidential economy conference in which Cabinet officers were urged, "Don't waste paper clips." [9] Budget pressure continued in subsequent administrations. For example, in 1933 the Roosevelt administration imposed a $500,000 budget cut and a 15 percent workforce reduction on the Air Regulations Division [10].

Faced with these pressures, early leaders of the AB strived to develop procedures that would further the cause of safety without the need for a huge government workforce, while also satisfying industry stakeholders. For example, airworthiness rules were based on the concept of the type certificate. The Department of Commerce set minimum engineering standards. Aircraft manufacturers sent blue prints and engineering data to the AB. If these met the standards, an inspector would visit the plant to determine whether the manufacturer was following the approved design. This was followed by flight tests, first by a company test pilot and then by the federal inspector. If the test was passed, the AB issued an aircraft type certificate authorizing the manufacturer to produce aircraft with the exact same specifications. Such aircraft were given airworthiness certificates, without federal inspection, if the manufacturer certified in an affidavit

that he had followed the specifications of the type certificate and the aircraft had been flight-tested. Manufacturers who opted out of this process were forced to submit every plane they produced for the analysis and tests undergone by a type-certificated model [11]. As aircraft speeds increased, sometimes to the point of causing vibration in the airframe, the certification specified maximum speeds [12].

Engines posed a somewhat different challenge. Where a single flight test was deemed adequate to demonstrate airworthiness, engines had to be proven reliable. Engines submitted for type certification were subjected to extended endurance tests followed by tear-down and inspection. If the test or subsequent inspection revealed the failure of any major component, certification was denied [13]. The engine tests proved difficult, with around 50 percent of engines failing during the early years [14].

The ACA required that pilots pass regular medical exams. Again, the AB sought a means of implementing this provision that avoided large government expenditure. The solution was to designate doctors in private practice to perform the exams and leave it to the examinees to cover their fees. This left the AB with the much more manageable chore of designating doctors instead of employing a large medical staff [15].

Despite these measures, the initial budget provided for AB safety oversight proved completely inadequate for the task. Backlogs for all kinds of inspection and certification services quickly developed. To avoid inconveniencing, and potentially stifling the industry, the AB instituted a policy of issuing temporary certificates and licenses. Although increased budgets in later years enabled the AB to bolster its staffing, the burgeoning interest in aviation, as well as the ever increasing workload associated with renewing licenses, made it virtually impossible for the AB to catch up. Only after the slowdown in aviation in the post-1929 economy did the backlog finally clear [16].

The oversight system revolved around inspectors. Inspectors were assigned to eleven districts, each controlled by a supervising air inspector. Each inspector was assigned to particular centers of aircraft activity and traveled from one to another based on an itinerary drawn up by a supervisor. At each stop, he inspected factories, tested aircraft, and examined pilots and mechanics [17]. Later, in a 1933 move to reduce the budget, the number of districts was reduced to eight, and users were required to travel to the inspector's location [18]. Accident investigation was another inspector duty. Inspectors worked long hours and were paid considerably less than those with similar expertise in private industry [19]. Their jobs were also hazardous, particularly when conducting flight testing pilot-licensed applicants. In 1929, three inspector fatalities occurred during flight testing [20].

Inspectors in the field were often far less lenient than headquarters officials. There are anecdotes of inspectors abusing their authority, cutting a fabric wing with a pocketknife while saying "I don't think this is strong enough" or stating "I don't like this plane and I'll tell you why—I just don't like it." Pilot licenses might also be pulled even for minor infractions. The fear and respect accorded inspectors may have been instrumental in keeping some in the job despite its low pay and long hours [21].

Backlogs were not the only reason for granting temporary certificates and waivers. About 10 percent of pilot license applicants were permitted to fly even though they did not pass medical tests. The general policy was to do this when pilots did not intend to engage in aviation as a business. Likewise, even when an aircraft failed initial certification tests, the AB would sometimes grant temporary certificates to give the manufacturer time to remedy the defects rather than effectively forcing it out of business.

This liberalism had its price. Over a 3-year period, the fatality rate of pilots flying under a waiver was 2.4 percent compared to 1.5 percent for those who met all requirements [22]. There were several crashes in the late 1920s involving catastrophic failures of aircraft operating under the temporary certificates. Confronted by a New York Times reporter writing a story on these incidents, Director McCracken agreed that they reflected the difficulty of reconciling the promotional and regulatory responsibilities. In reply, the reporter observed "You have been confronted with an appalling job." [23]

In addition to the pressure for a liberal approach in interpreting its existing rules, the AB was faced with a variety of calls for changing the rules themselves. Given the rapid evolution of the industry, as well as the many lessons learned from initial experience with the oversight program, it is not surprising that many adjustments were in order. The difficulty was in maintaining the continuity of the oversight program while responding to suggestions and pressures from every corner of the aviation industry. Flying schools sought deferral of medical exams until students were about to fly solo and longer minimum solo flight times for license eligibility. The father of a 16-year-old pilot killed in a crash pushed for increasing the minimum pilot age to 18. Football fans mourning the death of Knute Rockne in an air transport crash argued that air carriers should be required to carry parachutes.

More significant were changes advocated by the air carrier industry. When many licensed mechanics were found to be incompetent, the AB toughened examinations. A loophole that allowed air transport pilots to have their flight test on any aircraft—even a one or two seater—was modified to make the test and license specific to each type of aircraft. A new pilot category, Scheduled Air Transport, with stricter requirements was established. Crew requirements were modified to require co-pilots, albeit with a Transport rather than a Scheduled Air Transport license, on larger planes used in scheduled transport. The stricter requirements became a factor in labor relations when AB inspectors disqualified half of the replacement pilots hired by Century and Pacific Air Lines to replace those it had dismissed in a labor dispute [24].

Most importantly, beginning in 1930, certification requirements were extended from pilots, mechanics, and aircraft to the business enterprises that employed them—airlines and flight schools. In response to a series of serious accidents in the later 1920s and a rising sentiment in Congress that airline safety regulation responsibility should be transferred to the Interstate Commerce Commission, the AB ruled that beginning in 1930, companies conducting scheduled air passenger operations had to have a certificate of authority. To be certified, an airline had to have adequate ground organization and maintenance procedures, a sufficient staff of licensed pilots and mechanics, and aircraft that met government equipage and instrumentation requirements [25]. The new rules required the creation of a new inspector force. Four 3-person

teams, consisting of two inspectors and a maintenance inspector, were created and assigned to bases in New York, Chicago, Dallas, and Los Angeles [26].

An additional set of commercial airline safety rules were issued in 1935, by which time the AB had been re-designated the Bureau of Air Commerce (BAC). The new requirements included multiple-engine planes capable of flying on one engine for night flying, multi-engine aircraft with two-way radios for instrument flying, limits on flight hours for pilots, and BAC approval of airline dispatching procedures and personnel [27]. BAC certification of airport controllers, airline employees at the time, also became mandatory [28].

Looking back on the first decade of the ACA, the BAC could cite some impressive statistics. Its success in promoting aviation could be seen in the several hundred-fold increase in the number of pilots, airmail revenue, and passengers carried between 1927 and 1937. At the same time, the rate of fatal accidents per aircraft mile had decreased by a factor of 10 for scheduled airline service, and a factor of four for other flying [29].

Despite these gains, there was rising sentiment during the late 1930s that federal aviation activities should be reorganized. The sentiment was fueled by a number of events, most prominently the crash of a TWA airliner carrying Senator Bronson Cutting in 1935. The BAC investigation suggested that poor weather, a malfunctioning radio, questionable decision making by a TWA dispatcher, and the pilot's violation of a rule against instrument flying without a working radio all contributed to the event. An investigation by the Senate pointed the blame mainly at the BAC, citing problems with the equipment it provided for instrument landings, as well as irregularities in the Bureau's regulatory process. The conclusions of the Senate investigation were probably tainted by TWA's efforts to shift blame and avoid legal liability, but they pointed to a conflict of interest faced by the BAC when it investigated accidents [30]. This combination of circumstances led many to conclude that responsibility for accident investigation, and perhaps all safety matters, should be shifted out of the Department of Commerce. This idea gained further momentum when combined with a package of other aviation reforms that included, for the first time, direct economic regulation—a measure strongly supported by the established airlines but with less broad-based support than actions to promote safety. In the words of Commons, "And so it was that the Bureau of Air Commerce became a sacrificial pawn in a game played by the airlines to ensure their own survival." [31]

1.2 SAFETY OVERSIGHT UNDER THE CIVIL AERONAUTICS ACT.

The Civil Aeronautics Act, passed on June 23, 1938, created the Civil Aeronautics Authority (CAA), consisting of an Administrator and a five-member board, along with a three-person Air Safety Board. The CAA heard complaints, determined rates for mail and passenger service, issued route certificates under the Act for airlines offering scheduled service, promulgated safety rules, and formulated general policies for improving the efficiency of the airway system [32 and 33]. The sole purpose of the Air Safety Board was to investigate accidents. The Administrator's duties included developing and maintaining the airway system, air traffic control, and performing other duties the CAA might delegate to the Administrator.

The Civil Aeronautics Act prohibited the CAA Board from delegating safety responsibilities, including regulation, certification and inspection, and enforcement to the Administrator. In practice, however, it was not considered feasible to create a whole new administrative apparatus to handle safety functions. As a work-around, the CAA eventually created the position of Supervisor, who reported to the CAA Board and administered its safety work; this gave the CAA Administrator the Supervisor position as well. The Administrator was thus independent of the CAA in the role as provider of air traffic services, while serving under the CAA in activities related to safety.

The CAA inherited the safety regulation responsibilities that had belonged to the BAC. These responsibilities included licensing, which was required for pilots (with six levels ranging from student to air transport), maintenance technicians, and aircraft repairmen. Certification was required for mechanics, aircraft repair station operators, parachute riggers, and air carriers [34]. Airworthiness certification was also in the CAA domain. As before, this process was expedited using type certification. Under the CAA, these licensing and certification requirements applied to intra- and interstate flying.

Along with these safety functions, the CAA also inherited the inspector workforce. Inspectors now worked out of seven regional offices, a consolidation from the previous nine instituted by the BAC in 1938. The inspectors were, as before, underpaid and overworked. One inspector was reported to have had 23 pilots awaiting tests on a single day [35]. Exacerbating the problem, many candidates for pilot licenses attempted their flight examination before they were ready, forcing inspectors to act as instructors [36]. The inspectors' lot was further diminished by the elimination of one of their most valued perks: free airline flights. To eliminate a potential conflict of interest, the Civil Aeronautics Act forced inspectors to pay for all flights not taken for official business [37].

CAA inspectors were the object of a variety of complaints, often reflecting the temptation to cut corners in the face of excessive workload. One inspector drew a reprimand for recording the same grade for each of 120 students taking an examination, and another for being too lenient in re-rating flight instructors [38]. The head of an airline charged that the CAA was certifying unqualified mechanics [39]. Errors in inspector reports were considered a major problem by the Bureau of Safety Regulation, prompting a suggestion that a competition among the regions be organized as a means of improving accuracy [40]. Nonetheless, large backlogs were reported, with one midwestern community reporting a 3-month backlog of inspector work despite receiving monthly visits, and another town complaining that no inspector had visited in several months [41]. The problem of inspector belligerence also continued, with reports such as a Chicago-based inspector on assignment to Peoria "apparently resenting this assignment and taking out his ill feelings on the applicants of Peoria." [42] Air carrier pilots complained of "inspectors barging into cockpits." [43]

The tension between promotional and regulatory mandates also remained. The regulatory philosophy, as articulated by CAA Board member Edward Warner, (was to protect the responsible flier from the irresponsible, not to end all accidents, nor to protect every fool from himself. For the careful flier, the regulations should be hardly noticeable, since the procedures they stipulate are ones he would follow anyway) [44]. Another aspect of this spirit was to

modify the rules to avoid excessive inconvenience or delay. Rather than keeping a repaired aircraft grounded until an inspector could check it, the CAA granted 30-day waivers. Responding to a new wave of pilot license applications, the CAA allowed flight schools to conduct flight tests on its behalf, using spot checks to ensure that this was done properly [45].

The administrative structure created under the Civil Aeronautics Act did not last long. Disputes between the Administrator and the Chairman of the CAA Board and among members of the Air Safety Board highlighted shortcomings in the organizational structure created by the 1938 legislation. These problems came to the fore at a time when government reorganization was the order of the day. The Reorganization Act of 1939 was aimed at improving the ability of the President to supervise the burgeoning activities of the executive branch of government under the New Deal. To do so, it called for moving independent agencies into executive departments whose leaders could identify matters requiring presidential attention. The CAA, with its personal rivalries and structural defects, had perhaps required too much of such attention in the months since its creation and became a natural target for relocation. Roosevelt proposed, and the Congress approved, a reorganization that shifted administrative powers from the CAA Board, renamed the Civil Aeronautics Board (CAB), to the Administrator. Roosevelt and Congress abolished the Air Safety Board, made the CAB responsible for accident investigation, and placed the CAA Administrator back in the Department of Commerce.

With the reorganization, safety regulation became an explicit responsibility of the Administrator rather than a delegated responsibility of his now defunct alter ego, the Supervisor. Under the Administrator, the Office of Safety Regulation was assigned the safety regulation mission, which included five divisions. The General Inspection Division looked after private fliers, examining and testing pilots and other airmen, as well as inspecting aircraft for airworthiness. During World War II, inspectors in this division were also assigned the tasks of making sure that certified airmen were loyal to the U.S., and that private aircraft did not fall into the wrong hands. The Air Carrier Division oversaw airlines, with inspectors specializing in maintenance, operations, or radio. Most of the work was done at airline headquarters, where inspectors worked closely and continuously with airline personnel. The Aircraft Engineering Division reviewed aircraft design documents and stress analyses of new aircraft models to make sure that the proposed plane would be structurally sound. Finally, the Flight Engineering and Factory Inspection Division performed the flight tests that completed the type certification process and performed factory inspections to make sure that each manufactured aircraft was built according to the approved drawings of its prototype.

The successive restructurings arising from the Civil Aeronautics Act and Roosevelt's reorganization marked a period of dramatic fluctuations in the air carrier accident record. Between March 26, 1939, the date of a fatal Braniff crash, and August 31, 1940, when 25 died in a Pennsylvania-Central crash, U.S. domestic airlines flew 1.4 billion passenger miles without a fatal accident. The fatality rate per passenger mile for 1939 as a whole was just a quarter of that in 1938, which, in turn, was about half that in 1936-37 [46]. Then, in the eight months after the reorganization, there were five fatal airline crashes, and the 1940 fatality nearly tripled that for 1939 [47].

Both the 1939 improvement and the 1940 reversal garnered considerable discussion in the aviation community. Regarding the former, observers pointed to an agreement between top officials at the newly created CAA and the Air Transport Association to make a concerted effort to go an entire year without a fatal accident. Toward that end, airline executives worked out mutual cancellation agreements that made it easier, from a competitive viewpoint, to cancel flights in poor weather [48]. Another explanation was that pilots had become accustomed to the DC-3, which had been introduced in 1936 and by 1939 had become the dominant aircraft in the domestic airline industry [49]. Others contended that the economic order created by the Civil Aeronautics Act had launched the industry on an upward spiral of higher profits, greater expenditures on safety, and an improved accident record, leading to higher demand and further profit gains. When testifying before Congress, CAA officials were more than ready to contend, and their politician interlocutors more than ready to believe, that credit for the improved record should go to those who passed the Civil Aeronautics Act.

As to the subsequent upturn in accident rates, defenders of the reorganization argued, with considerable justification, that this was pure coincidence. Representative Clinton Anderson from New Mexico compared the situation to the reduction in rainfall in Kansas that occurred after the relocation of the Weather Bureau in Dodge City [50]. Others speculated that the fluctuations represented a general pattern occurring in all forms of transportation in which operators become more confident, and thus less vigilant, after a period of safe operation [51]. A congressional select committee, led by Oklahoma Congressman Jack Nichols, was created to investigate the increase in the accident rate. The committee worked for 17 months, issued 20 reports, and introduced four bills, none of which won passage. While identifying several shortcomings, such as poor airport lighting that contributed to the accidents, the committee found no link to the reorganization nor did any of its recommendations pertain to safety regulation or oversight.

While not implicated by the Nichols committee, there was trouble brewing in the inspector corps. Soon after Theodore Wright, Truman's choice for CAA Administrator, took office, articles criticizing the General Inspection Division began to appear in the trade press. At first, they echoed the earlier observations that inspectors treated general aviators discourteously and "were too blunt and not…as cooperative as they could be." [52] Soon after, in June 1945, the Non-Scheduled Flying Advisory Committee, a body established by Wright to represent the concerns of the developing nonscheduled air carrier industry, made more serious accusations. Charges included conflict of interest, favoritism, bribery, absenteeism, and other forms of malfeasance [53]. While several inspectors were fired or reassigned, Wright's inability to carry out a more thorough housecleaning, particularly of upper-level managers who had allowed, or at least tolerated, corrupt practices among the inspectors, led eventually to his departure in 1948 [54].

Wright left his mark, however. He led a fundamental transformation in the CAA's approach to safety oversight, from one that focused on direct inspection by civil servants to one that delegated this function to others, recasting the government role as one of "inspecting the inspectors." [55] This innovation was known as the "designee program," and its roots extended back to the first days of the AB when selected private physicians were assigned the responsibility of providing pilot medical checkups. A further move in this direction was made just before World War II, under the Civilian Pilot Training Program (CPTP). The CPTP was designed to encourage private flying by subsidizing pilot training for college students [56]. To reduce the

burden of certifying the new pilots, the CAA allowed flight instructors employed by colleges and flight schools to certificate pilots. CAA responsibility was restricted to spot checking the pilot training itself, along with one to two pilots in each class of trainees [57].

Wright extended the designee concept by creating two additional classes of designees. Factory designees were employees of aircraft manufacturers and were allowed to certificate personal aircraft. Testing designees, employed by fixed-based operators, were allowed to test and certificate pilots [58]. The program proved popular to all concerned. Designees valued the prestige as well as the status of their new role. Manufacturers and owners appreciated the faster service [59]. The CAA was able to achieve an order-of-magnitude improvement in the productivity of its safety oversight system. Its estimated savings in 1948 was $5.3 million, with one official able to accomplish work that would have required 20 to 30 CAA employees without the program [60].

The designee program served the nonairline community, but it reflected a philosophy of decentralization that extended to other matters as well. At the organizational level, Wright attempted to regionalize the CAA. Under his reorganization, activities in Washington would be confined to policymaking, while policy administration would be left to the regions, within easier reach of airlines, pilots, manufacturers, and other customers [61]. With respect to safety oversight, headquarters' responsibility resided with the Assistant Administrator for Safety Regulation, while the regions had separate branches devoted to airmen, aircraft and components, and flight operations [62]. A second example of this approach was the development of technical standard orders (TSO) as a means of simplifying the aircraft certification process. TSOs specified requirements for aircraft components whose fulfillment could be ensured by supplier warranty instead of certification. Certification was still required for aircraft, propellers, and engines, but the use of TSOs for other components further eased the workload of inspectors, and in the words of Wilson, "appears to have been an essential step if civil aviation was not to collapse in a massive tie-up of red tape." [63] The TSO concept was later extended in 1951 to include the planes themselves if they weighed up to 5000 lb or could carry no more than five people. Here, the practice was made optional, because some manufacturers feared it would increase their liability in the event of failure [64].

During the 1940s and 1950s, the safety oversight system faced the ongoing challenge of reconciling conflicting forces concerning the body of regulations that were to be enforced. A dynamic that developed over these years worked as follows. A series of accidents would bring aviation safety into the public, and more importantly, the congressional and presidential consciousness. An investigation would be undertaken, resulting in a recommendation for new rules that might have prevented the accidents. This would result in additions to the Civil Aviation Regulations. Meanwhile, many aviation stakeholders complained that the regulations were too complicated, resulting in unnecessary burdens to them, and in some instances, an actual increase in risk. Some observers claimed that, with time, the CAA began to internalize this process, adopting overly stringent regulations to head off yet another critical committee report after the next big crash.

One of these episodes occurred in late 1946, when a series of seven fatal domestic airline accidents and five others involving foreign carriers sparked investigations by committees in both

the House of Representatives and the Senate. The most strident criticism in these hearings came from pilots, who claimed that, through overregulation, the CAA had stifled the resolute attitude that had enabled the 17-month period of fatality-free flying in 1939-40. Rule adherence had supplanted safety as the primary goal. One pilot testified that, when facing a serious weather problem, his thought process had become, "Is it legal? If I break this rule will I be able to justify it later so I won't be grounded or fined? Will I have to write a letter of explanation? Will I have to attend a hearing? And—Oh yes! As an afterthought, is it safe?" [65] Yet, these comments notwithstanding, one of the CAA's responses to these crashes was to further restrict the pilots' discretion in deciding whether or not there was sufficient cloud ceiling to land [66].

A Boeing engineer made similar criticisms about the certification requirements for air transport aircraft, claiming that air transport planes had become "oversafetied." A new mechanical device might be required for the cockpit, followed by a second device to ensure that the first one operated properly, then a warning light to make sure that the second device was working, and finally a test switch for the warning light. Meanwhile, these requirements would apply only to new models, leaving airlines free to operate older types without these components. The direct cost and weight penalties of the required equipage on the new planes gave the airlines that much more incentive to continue using the older ones [67].

The tragic series of crashes that occurred in the New York City area beginning in late 1951 also illustrates the phenomenon. On December 16, 1951, a Curtis Commando C46 crashed while attempting to return to Newark airport after an engine failure, killing all 56 occupants. A month later, an aircraft on approach to La Guardia had a nonfatal crash into the water. A week after that, an aircraft departing from Newark crashed into a six-story building killing 23 in the plane and six on the ground. Not a month later, another aircraft taking off from Newark crashed, killing 31, including four on the ground. This provoked the emergency shutdown of Newark; however, in early April, a C46 freighter crashed on approach at Idlewild, which had absorbed much of the Newark traffic, killing the crew and three people on the ground [68].

The investigation in this instance was carried out by a House of Representatives subcommittee that found, among other things, that airworthiness requirements were deficient. The C46s, in particular, were known to be failure-prone and not certificated for scheduled airlines. They were used extensively by the nonscheduled airlines, however, who exacerbated the hazard through poor maintenance and payloads that exceeded those allowable for certificated carriers. The Office of Aviation Safety (OAS) also came under criticism for lax enforcement of the regulations that did apply [69].

Despite these criticisms, the statistical record shows continuing progress in various indices of safety, as shown in figure 1 [70]. Three indices are plotted, all using 1950 as the benchmark year with a value of 1. The first index is based on fatal accidents per airplane mile and the second on fatalities per passenger mile, both for domestic scheduled air carriers. The third index reflects fatal accidents per airplane mile for all other domestic operations. All of these indices showed progress over the 1940s and 1950s, although the air carriers results were erratic enough so that the "up ticks" could raise justifiable concern. With the exception of a postwar increase, nonairline flying showed the steadiest progress in safety, although in the longer run, this has also proven to be the slowest. In assessing this record, it must be recognized that safety oversight was

not the only, or perhaps not even the most important, factor. Advances in air navigation and air traffic control, aircraft improvements, changes in traffic patterns, and improvements initiated by the air carriers themselves, all contributed to the gains in safety.

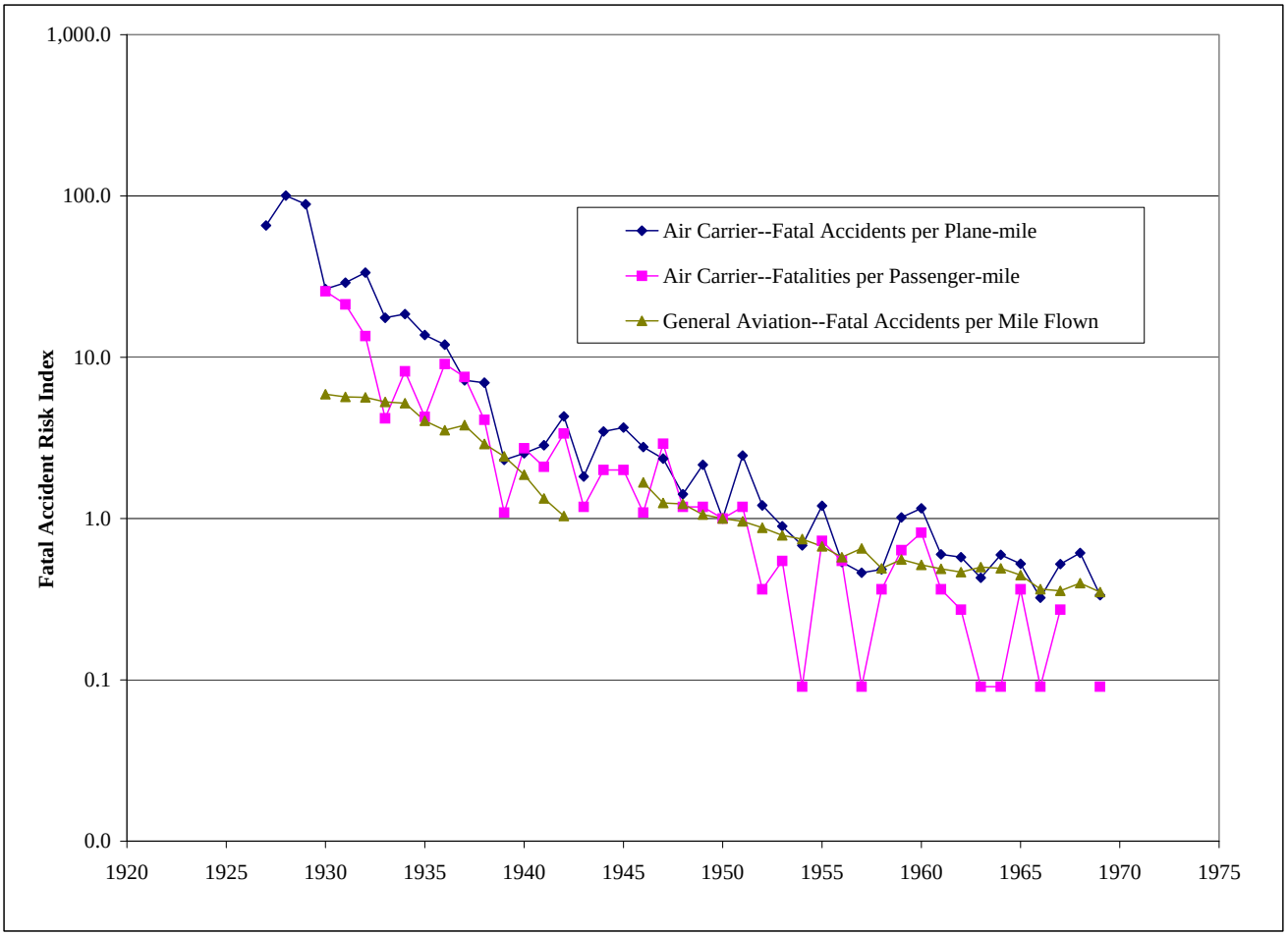

Figure 1. U.S. Air Carrier Safety Indices, 1920-1975

The CAA safety program underwent one more reorganization as the 20-year democratic reign in the White House drew to a close. In a bid to establish clearer lines of responsibility for safety and to simplify relations between the CAA and its customers, the headquarters OAS was reconstituted to include divisions of Air Carrier Safety and General Safety. A similar structure—including an Aviation Safety Division with branches for Air Carrier and General Safety—was created at each of the seven regions. The move sparked great controversy, not so much for the new organization per se but for the means by which top managers were selected. The process seemed to place more weight on administrative skill then technical expertise and was arguably too subjective since interview results were given a weight of 50 percent in the evaluation process. The controversy rekindled old charges that the OAS was overbureaucratized, dominated by an old guard bent on maintaining and building their own individual fiefdoms, and still tainted by a culture of corruption. In the latter regard, critics charged that inspectors had overlooked maintenance deficiencies in exchange for help in smuggling liquor into the U.S. [71].

1.3 THE EISENHOWER YEARS.

Already reeling from its reorganization at the end of the Truman administration, the OAS faced a new, even more challenging, environment with the ascendance of the Republicans. Secretary of Commerce Sinclair Weeks proclaimed "a clear mandate to slam the brakes on the waste, extravagance, and duplication of the past 20 years" and that the new administration would "cancel some existing functions of government and sling the ax on deadwood and poison ivy." [72] According to the President, "The national interest will usually be served best by a privately and owned and operated industry, which is supported by a minimum of federal funds or federal basic facilities and services operated at the lowest feasible cost and financed, where possible by charges levied on the users of services." [73]

Weeks's budget reflected these views, paring the CAA's original request by 30 percent [74]. The OAS became a major target. The regional approach to administering safety oversight was scrapped; inspectors now reported directly to Washington. The designee system was expanded to include airlines, and the federal inspection program was changed to focus more on recognized trouble spots [75]. The new regime was predicated on the idea that "the airlines were already proving they had the maturity and capability to take over much of the safety enforcement function and perform it more effectively" than the OAS, which was seen "as a 'bloated empire' and 'snug haven' for political hacks and senior employees." [76] OAS's responsibilities were further reduced in 1954 when safety regulation enforcement was transferred to the Office of General Council [77]. Defending criticism that the workforce reductions at the CAA might compromise aviation safety, Under Secretary of Commerce for Transportation Robert Murray pointed out that the bulk of eliminated positions connected with safety were inspectors, as opposed, for example, to air traffic controllers, which were actually being added [78]. A consultant study intended to find more cuts again made inspection and certification activities a prime target, proposing a further reduction at OAS of 150 people and $840,000 [79].

The early policy of retrenchment—both for the CAA in general and OAS in particular—gradually gave way to a more supportive one. Many of the cuts at the CAA had the effect of reducing private fliers' access to the system, and this constituency was, as ever, vociferous in its response. The shortcomings of the air navigation and air traffic control systems were becoming more evident as the skies became more crowded, and the looming prospect of introducing jet aircraft into commercial service posed challenges that demanded a creative government response. Then, on June 30, 1956, TWA Flight 2 and United Flight 718 collided over the Grand Canyon, killing all 128 aboard. This calamity could be directly traced to shortcomings in air traffic control rules that gave airlines incentives to fly off the airways where separation services were not available, but it came to symbolize more broadly the perils of giving too much authority for aviation safety to the private sector. In the words of Senator McCarran: "There are still those in industry who have the same state of mind as the manufacturer who once told a former CAA administrator: 'You can wipe out all pilot regulations for all I care. The more they crack 'em up, the more planes I build.' " [80]

Responding to these events, the CAA was again reorganized in late 1956. While directed primarily at improving the ability to provide services related to air traffic control and air navigation, the reorganization also affected safety oversight. The OAS was renamed the Office of Flight Operations and Airworthiness, reflecting that its mission, while safety-critical, was

hardly unique in this regard. The new office was ordered to change the designee system, which had, in Rochester's words, "become as bloated as the OAS bureaucracy of the early 1950s." [81] The Director, William Davis, believed that it was more costly for the Office to oversee the designees than to do the inspections itself [82]. The changes were also a response to pressure from Congress, now controlled by Democrats, about the potential conflict of interest when a mechanic employed by an airline was certifying that airline's operations. While CAA staff maintained that spot checking removed this problem, Congress was not convinced [83].

Although the curtailment of the designee program gave the Office of Flight Operations and Airworthiness a more hands-on role in safety oversight, it did not prove up to the challenge, lacking the manpower to take on the work of the designees, as well as the technical expertise to handle the complexities of certifying jets. The aircraft industry began to refer to it by the derisive acronym "Flopair." [84]

1.4 THE FEDERAL AVIATION AGENCY.

At 12:01 AM on January 1, 1959, the Federal Aviation Agency assumed responsibility for the nation's aviation system. Its responsibilities included all those of the CAA, including safety enforcement. In addition, the FAA took over safety rulemaking activities that had previously belonged to the CAB, as well as the task of developing air traffic control and navigation systems that had heretofore been the mission of the Air Navigation Development Board.

While many factors contributed to this major change in aviation governance, the proximate cause was the recommendation of Edward P. Curtis, who had been appointed by Eisenhower 3 years earlier to undertake a long-range study of the nation's aviation requirements. Curtis's report, issued in May 1957, warned of a "crisis in the making" resulting from a fragmented administrative structure. This fragmentation included separation of civil and military aviation, of system development and system operating responsibilities, and of safety rulemaking and enforcement.

With regard to the safety issue, the Curtis report stated "The Civil Air Regulations are inextricably enmeshed in the air traffic and safety inspection systems. They are, therefore, operating rules which must be capable of practical application and practical adjustment." While the CAB naturally resisted and argued that safety and economic regulation are closely interrelated, this was clearly a minority position. Even a rearguard effort to permit appeals of FAA regulations to the CAB on the grounds of excessive economic burden was defeated. Only investigation of accidents involving large (over 12,500 lb) aircraft remained in the CAB domain, on the grounds that this was necessary to preserve "separation of powers."

Safety rulemaking responsibility was divided between two parts of the FAA. The Bureau of Flight Standards dealt with all aspects of safety regulation except aircraft collision avoidance and air traffic routing, which came under the purview of the Bureau of Air Traffic Management. Flight Standards absorbed the CAA Office of Flight Operations and Airworthiness while also taking on rulemaking authority that had been vested in the CAB. The Bureau continued to live up to its Flopair moniker, however, leading the Administrator to assume its rulemaking duties and, soon after, to replace its director [85].

The creation of the FAA heralded a reinvigorated approach to aviation governance. Ellwood Quesada, a distinguished military aviator who became one of the youngest Air Force Lieutenant Generals before retiring at the age of 47, was appointed as the first administrator. He took initiatives on many fronts, strengthening the research and development (R&D) program, increasing civil access to military airspace and facilities, asserting an expansive definition of FAA powers in relation to pre-existing organizations such as Radio Technical Commission for Aeronautics (RTCA) and CAA, and orchestrating the consolidation of military and civil air traffic control functions into a single, modernized system.

Safety oversight occupied a prominent place among this wide range of endeavors. In late March 1959, just weeks after Quesada's senate confirmation, the FAA sponsored a conference on safety rulemaking and enforcement in Oklahoma City. There, the Administrator announced plans for an aviation safety initiative featuring more assertive use of rulemaking and an enforcement program emphasizing the four F's—*firmness* in application, *fairness* in considering the interests of the public and airspace user, *faster* enforcement proceedings, and better investigations leading to a sounder *factual* basis for legal and administrative decisions [86].

Quesada's safety campaign focused on pilots, equipage, and carrier maintenance. A long-standing rule requiring flight crewmembers to remain at their stations was now rigorously enforced, while a program giving pilots immunity when reporting near-misses was ended. The FAA also succeeded, after a lengthy, acrimonious proceeding, in forcing airline pilots to retire at the age of 60. Commercial pilots also objected to an eight-fold increase, ordered by Quesada, in the proportion of transport mileage flown with FAA inspectors in the cockpit—from 0.2 to 1.6 percent [87]. This eventually led to an unauthorized strike in June 1960 by Eastern Airlines pilots in response to a message sent by their union—the Airline Pilots Association—that pilots should not takeoff when FAA inspectors sat, as directed by Quesada, in the "third pilot's seat" directly behind the captain [88]. The strike forced the cancellation of 90 percent of Eastern flights until it was ended by a court order and public condemnation 11 days later [89].

Training requirements for private pilot certification increased. Most vexing to this large but often neglected group was a return to the policy—abandoned just after World War II—that medical exams be given only by FAA-designated physicians. The Airline Owners and Pilots Associations (AOPA) responded with a torrent of rhetoric, accusing the FAA of trying to "outlaw the family physician," comparing Quesada to Fidel Castro, deluging the FAA with letters and postcards and promoting bills that would give the CAB review authority over FAA rulemaking [90].

The safety campaign also included new requirements for commercial aircraft equipage and maintenance. Airborne weather radar was now to be installed on all passenger aircraft, although an exemption was given to older models nearing retirement, and the requirement of flight recorders was extended to turboprop planes. The Air Transport Association questioned both moves, arguing that they would "inflict serious operational and economic hardships on the airlines." Quesada compromised only slightly, extending the deadlines for compliance but not changing the rules themselves [91].

Finally, Quesada's safety drive sought to end a widely perceived laxness in maintenance oversight. Rejecting the previous approach and stressing open communication between the CAA inspectors and airline personnel, the Administrator demanded strict enforcement with frequent fines, forced reorganization of deficient maintenance departments, and new regulations featuring more detailed standards and greater reporting requirements. The latter aroused intense industry opposition in response to both the onerousness of the regulations themselves and the lack of industry input into their development [92].

As Quesada's safety campaign went forward throughout 1959, air carriers suffered the worst spate of accidents since 1952, including nine fatal crashes with a combined death toll of nearly 300, the highest yearly total in history. The poor record led to Senate Aviation Subcommittee hearings in early 1960. Although Quesada's critics used the occasion to protest his strict enforcement approach, the Administrator argued persuasively, and with support from others, that his program had not had time to show results and that the large proportion of accidents caused by flight crew error or faulty maintenance underscored the need for strict enforcement.

While Quesada's arguments carried the day in 1960, his term at the FAA did not end pleasantly. On December 14, 1960, testifying before Congress, Quesada made a 2-hour farewell address in which he sharply criticized his Airline Pilot's Association (ALPA) and AOPA critics, who later answered in kind. Robert Serling summarized the situation: "Pete Quesada is a devoted, efficient public servant who also happened to be short-tempered, undiplomatic and, on occasions, admittedly arbitrary. Pilots are devoted, professionally efficient…and immensely proud to the point of occasional shortsightedness. Neither Quesada nor the average airline captain is the type to admit … that the other guy may be right at least some of the time." [93] And, unfortunately for Quesada and everyone else, the safety record in 1960 did not vindicate his approach, with 374 fatalities in domestic-scheduled operations, the trend in safety performance seemed to be trending steadily downward (see figure 1).

Quesada was succeeded by Najeeb Halaby, a former test pilot with a long record of distinguished government service. Halaby was faced with a major safety issue even before his confirmation hearing, in which he knew there would be questions about Quesada's certification of the Lockheed Electra, structurally modified after a series of crashes, for full-speed operation. Anticipating hostile questioning from Senator Vance Hartke, who had opposed Quesada's decision, Halaby flew the aircraft himself and concluded that it was airworthy. Responding to Hartke's diatribe against Quesada in the confirmation hearing, Halaby stated "I don't feel a responsibility to do things the way my predecessor did, nor do I feed a desire to overturn everything he did." [94] Halaby was easily confirmed.

Soon after taking office Halaby initiated, with White House approval, an aviation policy study to "define the technical, economic, and military objectives of the Federal Government throughout the broad spectrum of aviation, and provide sufficient definiteness to facilitate long-range planning." [95] The resulting report paid considerable attention to safety oversight, and its findings in this regard reflected the desire to get past the controversies that had beset the Quesada regime. They included giving general aviation a greater voice, simplifying the code of regulations, expanding the designee program, and returning to the cooperative approach to safety oversight of the pre-1956 CAA [96].

Halaby acted quickly to implement these recommendations while pursuing other initiatives to end the adversarial relationship between the FAA and users. He reached out to the pilot community by writing "Dear Fellow Airman" letters to 300,000 certificated pilots and a similar one to fixed-base operators asking for their suggestions and criticism. These were followed by forums, over which the Administrator himself would preside, and in which general aviation pilots were asked for their views on regulations. He undertook a review of the FAA's safety oversight procedures and followed most of its recommendations. This included creating a Regulatory Council with senior management from across the agency to participate in the rulemaking process, requiring a hearing before an independent examiner prior to suspension or revocation of a certificate, and delegating enforcement power back to the regions. Halaby also reinstituted the policy of giving immunity to pilots who reported near misses in which they were involved. Finally, the Administrator took measures to reduce misunderstanding of the Federal Aviation Rules, including rewriting and codifying them and publishing a magazine devoted to airline safety [97].

The move to delegate enforcement policy back to the regions was part of a more sweeping decentralization of the FAA. The headquarters bureaus were redesignated as services that would make recommendations to regional assistant administrators instead of issuing orders directly to their counterpart regional units. Many top managers at headquarters relocated to the regions to oversee the transition. To avert the inconsistency in standards that could result from the regionalized structure, Halaby started a daily Alert Bulletin and instituted weekly teleconferences with the regional administrators and a uniform directives system intended to clearly communicate FAA policies to the field [98]. The transition still proved difficult, partly because of reorganization fatigue throughout the agency and partly because regional administrators continued experimentation with subregional organizations [99].

Several safety oversight controversies that arose during the Halaby administration had significant labor-relations components. First, there was a protracted battle between the airlines, airline pilots, and flight engineers over union representation and cockpit staffing requirements. In an effort to score political points in this contest, members of the Flight Engineers International Association (FEIA) testifying in a congressional hearing produced photographs of flight attendants sitting in pilots' laps, suggesting that the FAA was too lax in pilot oversight [100]. Meanwhile, ALPA demanded the revocation of Southern Airways's operating certificate after the company fired its striking unionized pilots, replacing them with nonunion pilots. While the union claimed that this was causing serious violations in safety rules, an FAA investigation concluded that the problem was not serious enough to warrant such an action. Finally, the Airline Navigators Association fought to have the FAA pronounce the Doppler radar navigation unsafe, which would have eliminated the need for human navigators on the North Atlantic. Again, the FAA did not go along. While these episodes revealed that Halaby was not a pushover for those who used the safety card to further their special interests, they also hampered his efforts to improve relations with airmen stakeholders. In the words of Kent, "the existence of these and other labor-management problems made it impossible to introduce rationality, efficiency, and order into the troubled world of commercial aviation." [101]

A controversy surrounding the airworthiness of the DC-8 illustrates the challenging policy environment Halaby faced as well as his continuing desire to make aviation safety a cooperative

enterprise. In July 1961, on consecutive days, DC-8s veered off the runways upon landing in Denver and Miami. Inspectors suspected that hydraulic system failures and inadvertent engagement of thrust reversers had caused these mishaps, and the FAA made emergency amendments to flight manuals to prevent further incidents. The FEIA argued that a flight engineer should be part of the flight crew to detect the hydraulics problem. Halaby did not endorse that position, but ordered that flight crews be given a written test to make sure they could perform the necessary monitoring and emergency procedures in the event of failure. This in turn angered the pilots. In an attempt to avoid controversial and protracted rulemaking on the issue, the Administrator sent a set of proposed changes in DC-8 safety requirements directly to airline presidents, hoping that the matter could be resolved through voluntary cooperation instead of rule enforcement [102].

Halaby was forced to confront a safety issue that had dogged aviation policymakers since the late 1940s—how to oversee the nonscheduled airlines. These airlines were an artifact of the CAB's strict entry control in the scheduled airline market, combined with the determination of a group of entrepreneurs who, after World War II, sought to evade the controls by offering unscheduled airline service. To make up for their lack of regular schedules, these airlines charged lower fares and reduced their unit costs by providing higher seating density, inventing what is known today as coach service [103]. When the CAB permitted regular carriers to match these fares, nonscheduled airlines were forced to refocus on charter service, becoming known as supplemental carriers. Confined to the charter market and under frequent attack, in both the marketplace and the courts, from certificated carriers who viewed them as illegitimate competitors, nonscheduled airlines were often in precarious financial condition, surviving by the same grit that led to their creation.

Nonscheduled airlines' safety records had been spotty over the years; among their more notorious blemishes was the spate of crashes near New York City that triggered a safety crisis in 1951. Then, in late 1961, two nonscheduled airline crashes, one a military charter in which 74 Army recruits were killed, occurred within an 8-week period. This prompted several investigations including a joint one by the FAA and the CAB, which resulted in suspension of the operating certificate of one of the carriers along with recommendations for consolidated training and maintenance and "fewer, better and safer supplementals." [104]

Part of the problem was ambiguity in the safety oversight responsibilities of the FAA and CAB. Nominally, the FAA was the safety regulator while the CAB handled economic regulation. But the experience with the nonscheduled airlines showed that the economic posture of an airline affected its safety posture. Halaby thus announced that the FAA would now consider "capability of management personnel to assure safety" as well as "proof of financial responsibility" in certifying supplementals [105].

Turf issues also arose over accident investigation, nominally a CAB function, but one that required FAA cooperation and assistance, and whose end result was expected to inform FAA regulations and policies. However, if an accident revealed a significant hazard, then the FAA would sometimes take corrective action before the formal investigation, which stressed rigor and thoroughness, had run its course. The FAA's moves in these circumstances gave the appearance of pre-emption, as when the FAA issued an alert bulletin concerning a loose rudder bolt it

believed had caused an American Airlines 707 to crash while taking off from Idlewild Airport. In this instance, the Chairman of the Senate Commerce Committee charged that the FAA had "exceeded its statutory authority." [106] Halaby and his CAB counterpart Alan Boyd tried to smooth over these tensions but with only limited success because they were rooted in the "separation of powers" logic that underlay the original assignment of responsibilities to the two organizations.

Issues of sharing and allocating responsibility for safety between different parts of the aviation system and the FAA also arose. The DC-8 crashes in 1961 demonstrated the need for improving crash survivability, since many of the fatalities in one of the incidents resulted from a postcrash fire. While the FAA could have addressed this problem by improving the firefighting capabilities at airports, either by providing funding or by assuming direct responsibility, Halaby opted instead to focus on evacuation procedures and aircraft design standards [107]. When a series of accidents occurred in 1969, the FAA responded by focusing on improved flight crew procedures and requiring that aircraft be equipped with altitude warning devices, rather than, as some critics urged, investing more in Instrument Landing System equipment. In each of these instances, the FAA chose responses that increased requirements on users, and thus, on its own safety oversight system, rather than on improving the aviation infrastructure.

Other emerging hazards elicited more balanced responses. In 1963, three major airline accidents were attributed to turbulence and weather. The FAA responded with a multipronged effort that included changes in flight operations procedures and an evaluation program to make sure pilots were aware of the procedures, instructing controllers to provide more assistance to pilots in avoiding thunderstorm areas, and conducting research and development on methods for detecting hazardous weather and displaying weather information on controllers' radar displays [108].

Whatever the modality of the response, it was clear that by the 1960s, the FAA had developed the capability to quickly diagnose problems and prescribe solutions when crashes or near-misses revealed some new danger. When four Boeing 727s crashed during landing in 1965 and 1966, the FAA soon concluded that the problem was in the airplane's unusually high rate of descent, and instituted a set of changes in flight landing procedures, training requirements, and inspector monitoring designed to ensure that pilots could adequately control the aircraft during approach. [109]. When a study of near midair collisions showed that most of these events occurred in terminal areas near the busiest airports, it explored a range of options before eventually adopting the plan of establishing terminal control areas with additional aircraft equipage requirements. [110]. Complicating the technical challenges of these issues were the political ones of formulating responses acceptable to the various segments of the user community, the unions, Congress, and the public at large. As Kent observes, "The responsibility of keeping FAA on top of all potential safety problems bore down heavily on … all the men who held the top FAA job." [111]

Moreover, the agency still faced the eternal question of how to balance safety and economic concerns. For example, the Boeing 727 crashes in 1965-66 also rekindled concerns about crashworthiness, prompting rules requiring more, larger, better spaced, and more conspicuously marked emergency exits. But the rules exempted planes already in service, saving the industry from costly retrofits but maintaining the status quo to passengers in the meantime [112]. Similar

provisions designed to reduce the cost of complying with new regulations were included in later rules pertaining to seat flammability and passenger seat strength [113]. While this decision prompted harsh criticism from some quarters, it was consistent with decades of experience in which the FAA and its predecessors had steered a middle course between promotion and protection.

1.5 THE DEPARTMENT OF TRANSPORTATION ERA.

In 1966, Congress passed and President Johnson signed legislation creating the Department of Transportation (DOT). The DOT included the FAA—now the Federal Aviation Administration instead of the Federal Aviation Agency—along with the Bureau of Public Roads, the Coast Guard, and several other agencies. The idea for such a department extended back to World War II, and Halaby had urged moving in this direction in a letter to the President after departing the FAA. The specific reasons Johnson embraced the proposal are less than clear, but probably they included his desire to gain better control of the federal bureaucracy and improve government efficiency, in part to free funding for his Great Society programs [114].

Aviation safety issues figured prominently in the negotiations leading to preparation and passage of the final bill creating the DOT. Accident investigation responsibility moved from the CAB to the National Transportation Safety Board (NTSB), but Senator Monroney, a leading aviation advocate, insisted on protecting accident investigations from political interference by adding a provision that decisions of the NTSB be designated "Administratively Final" and transferring the entire CAB Bureau of Safety to the NTSB. Likewise, congressional leaders reached a deal with the White House that the FAA Administrator, not the Secretary of Transportation, would have final authority on matters related to safety [115]. Thus, while the creation of DOT was a tectonic event in U.S. transportation history, its impact on aviation safety and safety oversight was modest.

In the early 1970s, a new aviation safety issue came to the fore: hazardous materials. Cargo flights frequently carried hazardous materials, and freight compartments of passenger flights were also permitted to carry potentially dangerous commodities, including radioactive pharmaceutical products [116]. At congressional hearings in 1973, the FAA Flight Standards Director James Rudolph asserted that the agency was on top of the problem, citing recent training programs and frequent checks of hazardous materials shipments by FAA inspectors [117]. Other FAA witnesses stressed the industry's perfect hazardous materials shipment safety record over the prior several decades. Witnesses from outside the FAA were less sanguine, pointing, for example, to results of an audit in which 80 percent of shipments of hazardous materials were found to violate regulations [118]. Alexander Butterfield, the new Administrator, pledged that the shortcomings would be quickly corrected.

The perfect hazardous materials safety record was soon broken, adding to the pressure on the FAA to address the problem. In November 1973, a Pan Am freighter crashed on landing at Boston Logan International Airport. Its crew apparently blinded by a fire involving hazardous materials that the crew, ignorant of the shipment, thought was an electrical fire. A few months later, 100 people on a Delta flight were exposed to radiation from an improperly shielded shipment of Iridium-192 [119].

In the spring of 1974, Flight Standards conducted an assessment of its hazardous materials program. Inspectors cited progress, including growing skills in conducting hazardous materials inspections and a 20-fold increase in the number of inspections being carried out. Full compliance with regulations was still rare, however, with only 8 of 70 sampled shipments meeting all requirements. The inspection team who conducted the survey was not too troubled by these results, however, claiming that the emphasis in the FAA's regulatory philosophy was education rather than enforcement and that disciplinary actions were too time-consuming, particularly given the maximum penalty of $1000. The final report of the Flight Standards assessment recognized that compliance with hazardous materials regulations was inadequate but stressed that the problem was a multimodal one and seemed to downplay the FAA's role in solving it [120]. Others moved to fill this void. Pilots imposed their own embargo on hazardous materials shipments. Congress passed the Hazardous Materials Transportation Act, which gave regulatory authority to the Secretary of Transportation and limited the transport of radioactive cargo on airlines [121].

Flight Standards' apparent tolerance of hazardous materials violations, and its inclination to educate rather than enforce, was also evident in its response to a design flaw in the DC-10 that caused rear cargo doors to occasionally blow off in flight. The first such event occurred in June 1972, 1 year after certification, when a DC-10 took off from Detroit with rear door latches that were not properly secured. In this instance, the plane was able to land safely despite a jammed rudder. Staff in the FAA's Western Region headquarters began an Airworthiness Directive (AD) that would have mandated that all DC-10s be modified to make the cargo doors safe. The Administrator, John Shaffer, pre-empted this move by reaching a "gentleman's agreement" with Douglas's president, which called for the manufacturer to issue its own Service Bulletins in lieu of a government order. Furthermore, when the NTSB, on the basis of its accident investigation, recommended an additional safety measure not included in the Service Bulletins, the FAA responded by urging airlines to study the matter rather than ordering it with an AD [122].

The FAA's handling of this matter was subjected to harsh scrutiny when, in March 1974, a cargo door blew off a Turkish Airlines DC-10 as it climbed from Paris Orly Airport. Decompression forces disabled the aircraft's control cables and the resulting crash killed all 346 on board, the highest toll ever from a single accident. A congressional investigation highlighted the "gentleman's agreement" and the resulting report suggested that this was motivated in part to keep the problems with the DC-10 hidden from public view. There was a range of views concerning whether the AD would have made any difference with regard to the Turkish Airlines crash or hastened the upgrading of other DC-10 aircraft. In any case, the investigation revealed that the FAA and Flight Standards viewed the AD as a tool of last resort to be used when the agency was unable to gain sufficient cooperation through, as Shaffer stated in his testimony, "the person-to-person touch." [123]

The hazardous materials and DC-10 episodes pointed to problems in the Flight Standards organization that attracted the attention of Alexander Butterfield, who became the FAA Administrator at the beginning of Richard Nixon's second term. Observers identified a number of deficiencies. The most fundamental deficiency was insufficient resources to acquire the levels of manpower and expertise to keep pace with the civil aviation industry. Oscar Bakke framed the issue by noting that the DC-3 had required less than half a million engineering man hours to

develop while 19 million man hours were expended on the Boeing 747, without any corresponding increases in engineering resources for oversight. The agency was thus able to sample a much smaller percentage of the total effort involved in air commerce and had to delegate more of its oversight responsibility [124]. In addition to having insufficient manpower, Flight Standards was "dominated by an old-boy network of pilots who made decisions beyond their expertise in the fields of manufacturing and engineering," making them "dependent on private interest groups and hence lenient toward them." [125] The rulemaking process, which under the CAB had gone through an annual cycle of review and updating, but had since fallen into a more haphazard pattern based on "ad hoc efforts to respond to crisis," [126] was a further problem. Finally, Flight Standards faced organizational impediments from below, as a result of decentralization allowing some regions to give lower priority to safety oversight, and from above, because the Office of the Secretary of Transportation (OST) insisted on reviewing the FAA's regulatory proposals [127].

In congressional testimony soon after he took office, Butterfield expressed his intention to achieve "some truly significant gains in aviation safety" and reforms at Flight Standards figured prominently in efforts to do so [128]. His most ambitious plan involved creating an Associate Administrator for Aviation Safety who would lead Flight Standards, the Office of Aviation Medicine, and new units devoted to airport certification and aviation security. As Butterfield explained, he "wanted to be able to put his finger on one person's chest and say 'you are responsible' for safety matters." [129] A modified version of this reorganization plan, one which included the Associate Administrator for Aviation Safety but with a reduced range of responsibilities, took effect in June 1974 [130]. Other changes in the safety oversight system included (in the aftermath of the DC-10 affair) requiring that the FAA issue ADs for any safety-related modification and initiating a Biennial Airworthiness Review so that the process of updating safety regulations could be better systematized.

Try as they might, Butterfield and the FAA safety oversight team were unable to stay ahead of events. In addition to the Orly disaster, there was a series of Pan Am 707 crashes—in Tahiti in the summer of 1973, Bali in January 1974, and Pago Pago in April 1974 [131]. In September 1974, an Eastern Airlines DC-9 crashed on approach at Charlotte, North Carolina. Three months later, a TWA Flight 514—a Boeing 727—flew into a ridge as it attempted to land at Dulles. These tragedies triggered several investigations that culminated in late 1974 with an ABC News special report "Crashes: The Illusion of Safety," featuring footage of the Flight 514 crash, survivors' accounts, and an unimpressive interview with Butterfield. A critical report of a House subcommittee investigating the FAA's safety performance, chaired by Harley Staggers, made newspaper headlines on the same day [132].

These reports highlighted safety-related failings throughout the FAA:

- The Flight 514 crash was partly attributed to the failure of the FAA to clearly communicate the meaning of an approach clearance, leading the pilots to believe that they could begin their descent immediately when they first needed to clear a 3400-foot hill.

- Several of the crashes, including Flight 514, might have been averted if the aircraft had been equipped with a ground proximity warning system (GPWS). The FAA was criticized for failing to move quickly enough to develop and require installation of GPWS. The impression was reinforced by the decision to accelerate adoption of the GPWS requirement in the aftermath of Flight 514.

- The FAA was also accused of moving too hesitantly on measures to reduce the hazards of postcrash fire and explosion, as well as fires originating in the cabin itself. Some 40 percent of commercial airline fatalities in 1974 were the result of postcrash fires, but NTSB recommendations to require explosion-prevention systems, lavatory smoke detectors, and protective breathing devices for flight attendants did not result in prompt action.

- There had been no testing of the flammability of flight attendants' uniforms. (In a "test" done on the ABC show, the uniforms burst into flames.)

- The DC-10 and hazardous materials episodes were cited as additional examples of the FAA's failure to aggressively promote safety.

- More generally, the agency was accused of compromising safety—and sacrificing human lives—in favor of short-term economic benefits to industry, of slowness to act suggestive of "hardening of the arteries with advancing age," and of risking forfeiture of the confidence of the nation and the world [133].

Butterfield responded to these criticisms in several ways. First, he recentralized the Flight Standards activities related to engineering and manufacturing. Second, he ordered and expedited study of all NTSB recommendations that had not yet been acted on. Third, he created a blue-ribbon committee, headed by Richard Shoup, a Montana Congressman, to advise him on other immediate steps he should take in response to the Staggers report [134]. This group was soon disbanded in favor of a task force appointed by the Secretary of Transportation, Claude Brinegar, and headed by Assistant DOT Secretary, Benjamin Davis. Shortly thereafter, in early 1975, both Brinegar and Butterfield left their positions, the former resigning his post voluntarily and the latter forced out on Brinegar's recommendation.

The task of resurrecting the image of the FAA fell to James Dow, a former aircraft controller with three decades of experience at the CAA and FAA, who served as acting Administrator from April through November 1975. His initial steps were to expedite rulemaking and to re-establish a program giving immunity (with some exceptions) to pilots and controllers who reported dangerous incidents. A believer in a flat organization, Dow eliminated the Associate Administrator for Aviation Safety, creating a direct reporting line to Flight Standards. He also moved to require a more advanced flight data monitoring system that would record parameters relating to engine performance, instrument settings, and aircraft movement. This effort, however, was successfully opposed by a coalition of pilots concerned about the intrusiveness of the system and airlines who objected to its cost [135].

Despite the efforts of Dow and of his successor, John McLucas, the pace of rulemaking remained frustratingly slow. The Biennial Airworthiness review initiated by Butterfield eventually yielded 225 rule changes, and a similar review of operations regulations in 1975 generated 900 proposals for changes. It proved impossible to process all the changes in time to maintain a 2-year cycle, however. As of 1980, the FAA had yet to act on many of the recommendations from these reviews [136]. Moreover, even after a change was approved, the FAA was liberal in setting deadlines for compliance and in extending them when the airlines complained. When the FAA extended by 1 year a 1977 deadline for making changes to wide-body aircraft it had ordered in 1975 after the DC-10 accidents, the *New York Times*'s Tom Wicker characterized such decisions as "not necessarily outright bribery and graft, but the pervasive corruption of advantage, deception, greed and disregard for the public interest." [137] McLucas replied that it was the FAA's mission to protect the interests of both corporations and passengers, and that it had a good record of balancing them [138].

1.6 THE DEREGULATION ERA.

In 1978, Congress passed the Airline Deregulation Act (ADA), which called for immediate liberalization of economic regulation of fares and route entry, and the gradual curtailment of CAB authority, culminating with its abolition in 1985. The ADA had profound impacts on the structure, conduct, and performance of the airline industry. For a time, in the early 1980s, it appeared that the spirit of deregulation might carry over into the safety arena as well. In September 1982, the FAA proposed a new approach to safety oversight, called Regulation by Objective (RBO) that would replace detailed rules with broad objectives. The means of attaining the objectives would be left up to the airlines, subject to FAA approval. Under RBO, the FAA would monitor individual airlines' compliance with its attainment strategy using a computer tracking system. The FAA withdrew the proposal the next year in the face of negative comments, electing instead to continue to work on improving the existing regulations [139]. Thus, economic deregulation took place under a safety oversight regime quite similar to the one in place prior to 1978.

The postderegulation era nonetheless included a number of initiatives to update safety regulations and to refine the safety oversight process. Some were triggered by postderegulation changes in the airline industry. Others, as in earlier times, stemmed from accidents, investigations, and the decisions of top management to assert themselves in the safety arena.

Inevitably, deregulation created new challenges for the safety oversight system. First, the number of commercial carriers increased, doubling from 1979 to 1983 [140]. The process of certifying these carriers created an additional workload for the FAA inspectors. Second, many of the new entrant carriers contracted out their maintenance, further complicating the inspection process. Third, the lack of economic protection afforded by regulation increased concern that carriers in financial trouble would skimp on maintenance in an effort to cut cost. This prompted more intensive oversight of several carriers in financial difficulty, including Continental, Pan Am, and Eastern (and a record fine in the case of Eastern) [141]. Fourth, deregulation also increased the amount of aircraft leasing, which increased incentives of carriers to defer some types of maintenance activities for aircraft close to the end of their leases. Fifth, the increased emphasis on precise flight schedules necessary for efficient hub-and-spoke operations increased pressures on pilots and mechanics to overlook mechanical problems to avoid delays [142].

As the oversight system was responding to these new demands, it was also subject to a succession of investigations and inquiries initiated by top management at the FAA, the Secretary of Transportation, and Congress. In June 1980, the Committee on FAA Airworthiness Certification Procedures released its report. This committee of outside experts was created at the behest of DOT Secretary Goldschmidt in the aftermath of the crash of American Airlines Flight 191, a DC-10, just after takeoff from Chicago O'Hare in May 1979. The NTSB determined that the probable cause of the crash was the separation of an engine during takeoff, triggering a chain of events that made it impossible for the pilots to control the aircraft. The engine separation was attributed to improper maintenance procedures [143]. The crash thus raised questions about the initial certification of the DC-10, despite its vulnerability to this type of failure, as well as the FAA's systems for maintenance oversight. The Committee's report found "nothing … that would lead us to conclude that confidence gained in the airworthiness of our nation's transport aircraft is unwarranted," but that nonetheless "the airworthiness system can and should be improved." [144] Priority areas for improvement included:

- Establishing a central organization of top-caliber engineers who would guide rulemaking and establish design philosophy and criteria to guide the FAA inspectors' airworthiness certification activities.

- Modifying the nature of the type certification activities so that the FAA review occurred at designated milestones over the entire course of the design process.

- Enacting increased initiative in rulemaking, including annual rulemaking conferences.

- Creating a rule establishing the ability of an aircraft to fly even after a structural failure as a requirement for airworthiness (so long as the structural failure does not directly prevent flight).

- Performing more frequent and intensive inspections of manufacturers engaged in the production of type-certified aircraft.

- Increasing surveillance of airline maintenance operations, including more on-site visits and hardware observations.

- Updating licensing and training certification requirements for airline maintenance personnel.

- Periodically reassigning inspectors to different manufacturers and carriers.

- Accelerating development of an information-gathering and data system to support safety oversight activities.

- Requiring mandatory reporting of any damage to aircraft primary structures.

- Creating an independent safety board that would advise the Secretary of Transportation on aviation safety measures and recommend candidates for FAA Administrator and Deputy Administrator [145].

Partly in response to these recommendations, the FAA initiated development of the Aviation Safety Analysis System (ASAS). The goal of the ASAS was to support FAA safety oversight and decision making using computer technology. An important component of the system was the Work Program Management Subsystem, which was designed to reduce the paperwork burden of inspectors so that they could spend more time in the field [146]. The FAA took a number of other steps to better manage the workload of safety oversight over these years. These included adopting the lead region concept where certain regions would perform headquarters functions for different aspects of aircraft certification (for example, the Northwest Region became the lead region for certifying large aircraft) [147]. The agency attempted to encourage more assistance from airlines by promoting self-audit programs in which airlines would escape penalties for violations of safety rules uncovered by their own audits [148]. Another important component of the system was that the data collected were reported voluntarily by the pilots. This is the oldest voluntary reporting system in the FAA and is used today by pilots and others who are involved in aircraft operations. The National Aeronautics and Space Administration (NASA) administers this database [149].

In September 1980, the Special Aviation Fire and Explosion Reduction (SAFER) Advisory Committee released a report that was initiated as a result of a number of incidents during the 1970s in which fatalities occurred as the result of postcrash fires. The SAFER report recommended an all-out effort to develop antimisting kerosene, along with a wide range of other measures to prevent postcrash fires, to make aircraft cabins more fire-resistant, and to facilitate cabin evacuation in the event of fire [150]. These recommendations eventually led to a series of new rules issued throughout the mid- to late-1980s that were aimed at increasing fire safety and ease of evacuation of airliners.

Four years later, in March 1984, newly appointed DOT Secretary Elizabeth Dole—a safety advocate since her days as a consumer affairs deputy for Richard Nixon—initiated a safety review of all transportation modes, including aviation. The review included additional inspections of airlines supported by a 25-percent increase in the inspector workforce. This led to the 90-day National Air Transportation Inspection (NATI). The two-phase program began with across-the-board inspections of all major and commuter airlines followed by in-depth inspections of deficiencies identified in the first stage. Two hundred thirty-seven airlines and 25 other firms were inspected, of which 16 were found to have sufficient safety deficiencies to warrant significant enforcement actions, ranging from decertification to temporary grounding of aircraft or pilots [151]. The program was soon extended to pilot schools, repair stations, on-demand air taxis, and other elements of the system where safety vulnerabilities were thought to exist [152]. The NATI inspections were continued under the National Aviation Safety Inspection Program (NASIP), which targeted certain airlines each year for in-depth inspections. The series of special inspection programs continued in 1987 with one directed at the aircraft manufacturing industry. Called Operation Snapshot, the goal of the program was to ensure that manufacturers were following proper procedures and using up-to-date techniques [153].

During this same period, the FAA carried out a review of the Flight Standards function, called the Safety Activity Functional Evaluation (SAFE) Project. The results of the review, released in late 1985, included a call for increased standardization of inspection procedures and rule applications, improved training and inspector manuals, greater use of ASAS, the establishment of performance standards for FAA regional offices, and expedited updating of safety regulations. These findings were generally similar to those of the Dole review, released a few months earlier. The latter review also emphasized the need for improved communications within the FAA and between it and its customers. In response to these findings, the FAA, in October 1985, issued guidelines identifying 41 critical types of inspections and requirements for minimum numbers of such inspections for each airline within a region [154]. These requirements were known as the National Work Program Guidelines (NPG). Three years later, an Office of Technology Assessment (OTA) report noted that many of the improvements recommended by SAFE were underway, but moving "at a snail's pace." [155] A 1991 General Accounting Office (GAO) report concluded that, in 1990, 30 of the 83 Flight Standards District Offices had not completed all inspections required under the NPG, and that, among these 30, 28 percent of required inspections had not been completed [156]. The completion rate improved to nearly 100 percent during the early 1990s, mainly as the result of a sharp decrease in the number of required inspections, from 103,000 in 1990 to 46,300 in 1996 [157].

In 1987, the FAA came under criticism from the GAO for not analyzing inspector data in a way that would allow for targeting inspections or, in other words, not using inspector time effectively and potentially missing critical safety trends [158]. The Safety Performance Analysis System (SPAS) was the result of the determination by Flight Standards that inspectors, managers, and analysts could do a better job if they had access to reliable data to help with decision making and risk analysis. Initial groundwork was laid in 1991 with significant input from inspectors, and, beginning in 1994, from Professional Airways Systems Specialists (PASS) representatives [159]. SPAS was meant to allow a smarter way to do business by helping inspectors identify specific higher-risk areas and certificate holders and plan inspection activities better. Unfortunately, SPAS was dogged by delays and problems with data quality [160]. Full deployment of SPAS took 6 years, and SPAS and Air Transportation Oversight System (ATOS) were not integrated until 2002 [161]. The ValuJet crash in 1996 only increased the pressure to hastily deploy SPAS and, according to the GAO, was accompanied by insufficient training [162]. As will be discussed later, the introduction of ATOS faced similar difficulties.

The problem of aging aircraft emerged as a major challenge to the safety oversight system during the 1980s. Facing pressure to keep costs down, combined with falling fuel prices that reduced the advantage of newer models, airlines slowed the pace of fleet renewal, creating an aging aircraft fleet that posed unprecedented inspection and maintenance challenges. In the early 1980s, the FAA responded with the Supplemental Structural Improvement Program (SSIP), which called for manufacturers to develop special programs featuring additional inspections for aircraft with high in-service times. The SSIP inspections became mandatory in 1985 [163]. Despite these efforts, on April 28, 1988, a Boeing 737 operated by Aloha Airlines suffered a structural failure in its fuselage while in flight, resulting in an 18-foot gap and the fatality of a flight attendant who was swept through it. The NTSB identified the probable cause of the crash as the failure of the airline's maintenance program to detect structural defects caused by aging. The incident triggered renewed concern about the airworthiness of aging aircraft, leading to a 3-

day international conference and the creation of a task force [164]. Two years later, the FAA issued ADs requiring proactive steps to ensure the structural integrity of older planes, including parts replacement and airframe modifications. Later, the FAA added as an additional requirement that airlines implement corrosion control programs for certain types of older aircraft [165].

Economic pressures may have also contributed to a series of crashes related to inadequate deicing that sparked public attention and an agency response. Crashes of an Air Florida 737 departing National Airport in 1982, a Ryan International DC-9 carrying mail out of Cleveland in 1991, and a USAir Fokker F-28 departing La Guardia in 1992 were all attributed to excessive ice build-up on the aircraft wings. In the face of repeated NTSB recommendations, the FAA issued regulations calling for pilot and ground personnel training on the detection and removal of ice from wings and specifying conditions under which such procedures are required. An FAA official explained the lag: "when you think about the de-icing issue, we counted on pilots to do what was expected of them to do… So, we now recognize we can't count on them, you've go to do something different. There's a safeguard we can build in." [166]

1.7 THE SYSTEM SAFETY ERA.

The system safety philosophy is broader and more holistic than the traditional pursuit of safety through regulatory compliance. Indeed, it is a mantra of the present safety oversight system, and the words, System Safety, are prominent on the Aviation Flight Standards Service (AFS) seal. System safety approaches to regulation include the allocation of resources on the basis of risk, the need for air carriers to operate their own safety management systems that identify and mitigate hazards and risks, and the promotion of a safety culture in which each member of the organization strives for quality and safety [167].

System safety has its roots in Total Quality Management and other approaches to quality assurance that stress high reliability, participative management, continuous improvement, and performance monitoring. In the paradigm of system safety, the interfaces between systems receive the attention that individual systems do. It means that process elements such as documentation and implementation carry the same weight as physical design and testing. In the era of system safety, which is also an era of an excellent safety record, safety oversight learns to be conscious of the smaller, more latent failures that lead to crashes in order to maintain this level of safety.

1.8 THE VALUJET CRASH AND THE 90-DAY SAFETY REVIEW.

On May 11, 1996, ValuJet Flight 592, a DC-9, crashed into the Florida Everglades 10 minutes after takeoff from Miami, killing all 110 passengers onboard. The NTSB investigation concluded that a fire in a cargo area on the underside of the aircraft caused the accident. Although the cargo area was designed so that a fire would be suppressed by consuming all of the oxygen that was available in the cargo hold, the system was defeated by chemical oxygen generators, probably actuated by the fire (NTSB 1998). ValuJet's third-party maintenance contractor, SabreTech, was responsible for properly preparing and identifying the unexpended generators before presenting them to ValuJet for transport [168].

The ValuJet crash was a pivotal event in the history of the FAA's safety oversight system because decision makers at the time linked it to the FAA's failure to effectively oversee ValuJet operations. At the time of the crash, ValuJet was a rapidly growing carrier with a fleet that had grown from 2 to 52 DC-9s since operations began in late 1993 [169]. Its business model revolved around using highly depreciated aircraft, whose substantial maintenance requirements were outsourced to a number of widely dispersed repair stations. This combination of factors resulted in raised concerns at the FAA, resulting in special comprehensive inspections conducted in the fall of 1994 and 1995, and a special emphasis review on operations and maintenance activities that was underway at the time of the accident [170]. Administrator David Hinson, testifying before Congress a few weeks after the crash, identified two mistakes that the FAA had made relative to ValuJet: failing to understand and deal with the effects of rapid growth and failing to foresee the difficulties created by virtually complete outsourcing of maintenance. As corrective actions, he identified a series of steps designed to strengthen oversight and assure the quality of contract maintenance, and he proposed a 90-Day Safety Review that would assess the applicability of Federal Aviation Regulations to contract services, "staffing standards, workload distribution, and other related issues." [171]

For others, notably DOT Inspector General (IG) Mary Schiavo, the ValuJet crash occasioned more fundamental criticism of the FAA's oversight system. Testifying in the same hearing as Hinson, Schiavo summarized the results of 10 reports, containing 70 recommendations, that her office had issued over the previous 4 years. She first identified seven basic attributes of "effective inspections organizations":

1. They have an inventory of the entities they are responsible for overseeing;

2. They have a process for targeting high-risk activities;

3. They have well-defined inspection requirements that include the critical items that must be reviewed;

4. They have documentation showing what was inspected and the results of the inspection;

5. They have a system for communicating identified problems to the entity inspected;

6. They have a system to record, track, and follow-up on needed corrective actions; and

7. They have a process to periodically analyze the results of the inspections to identify problems that need to be addressed systemically [172].

The IG then used the results of the IG inspections to argue that:

- The FAA does not effectively target inspections, focusing the preponderance of its inspections on large operators, e.g., in one case, inspecting one plane 200 times in 1990, while failing to inspect 1100 aircraft operators at all in that year. The targeting problem was found to extend to repair stations as well;

- Inspections carried out were unsystematic and often rushed, frequently missing critical items such as brakes and landing gear, and yielding fewer enforcement actions than the more highly structured NASIP inspections;

- Inspection results weere often unrealistic because inspections were announced in advance and testing standards were too lenient;

- Many deficiencies found during inspections were not reported so that corrective actions could be tracked or enforcement actions initiated;

- Too little has been done to prevent the use of unapproved aircraft parts.

The 90-Day Safety Review was carried out by a task force with 14 core members, predominantly AFS personnel employed at headquarters, regional offices, and Flight Standards District Offices (FSDOs) under a steering committee consisting primarily of FAA senior executives, chaired by Deputy Administrator Linda Hall Daschle. Its focus was short term—to examine "areas of immediate concern" and "make recommendations that could be implemented in the near term." [173] The most immediate concern, obviously, was preventing another crash like Flight 592, and the review gave much attention to improving oversight for airlines like ValuJet. Of the six issue areas addressed in the review, two focused specifically on this subject. In the section on "Newly Certificated Air Carrier Operations and Growth," the review recommended that new carriers receive heightened surveillance during their first few years of operation [174] and restrictions be placed on operational specifications that force carriers to demonstrate the necessary infrastructure prior to increasing its scale and scope of operations beyond certain predefined thresholds [175]. Another section, "Outsourcing and Varied Fleet Mix," called for the AFS to ensure that air carriers have adequate capabilities to assure the quality of outsourced training and maintenance work and that outsourcing arrangements be included in airline maintenance manuals, and better coordination of repair station and air carrier oversight.

The 90-Day Review also carried a more general message: that the modern, deregulated, airline industry posed very different—and more difficult—oversight challenges for AFS. "What was once a centralized, stable, and relatively static air transportation environment, is today more fluid, expansive, and technology intensive." [176] While the rest of government was confronting the mandate to work better and cost less, AFS needed to do this while adapting to a significantly changed mission. Much of the review is devoted to achieving a mix of resource increases and productivity gains that could make all this possible.

On the productivity side, the review identified, and proposed remedies for, the inefficiencies in the process of certificating new carriers. These included the lack of coordination between the OST (responsible for assessing the managerial and economic fitness of an applicant) and the FAA (charged with certifying that the applicant had the ability to operate safely) differences among FSDOs in their interpretation of regulations and certification procedures leading to FSDO shopping, and frequent problems with applications that consumed large quantities of staff time and led to protracted, and often unsuccessful, application processes.

To address these concerns about certification and surveillance of new entrant carriers, on February 7, 1997, the FAA ordered the establishment of the Certification Standardization and Evaluation Team (CSET) [177]. The function of this new body was to provide expertise and support to FSDOs in their efforts to ensure that new entrant carriers had proper surveillance both at the time of certification and for the first 5 years following certification [178 and 179]. As needed, CSET also was to be prepared to help evaluate new entrant carriers. As the name of the team suggests, one of the underlying principles behind this initiative was that standardization of the certification process across FSDOs was crucial. In addition, CSET was given the task of encouraging communication and coordination between the Certificate-Holding District Offices (CHDOs) and OST, a lack of which had been noted in the 90-Day Review [180].

In practice, CSET started this process by providing seminars to all CHDOs who had new entrant carriers to help develop tailored surveillance plans for the new entrants [181]. The CSET seminars also helped to encourage consistent interpretation of requirements for new entrant carriers across CHDOs, thereby reducing the incentive for FSDO shopping.

By design, CSET was composed of FSDO personnel who would spend 2 years working as members of CSET. While the inspector staff would remain located at their home offices, by serving as part of CSET, role model district inspectors would become a resource nationwide, not just at their home offices [182]. Unfortunately, it is questionable whether CSET was able to achieve its goals, with Mike Fanfalone, President of PASS, stating in his testimony before the National Civil Aviation Review Commission, "[CSET] is hampered by the FAA's own internal bureaucracy." [183]

As a second strategy for "doing more with less," the 90-Day Review called for improved targeting of surveillance and enforcement resources. Rather than basing inspection plans on uniform standards for minimum levels of surveillance, the FAA should develop comprehensive plans tailored for each individual carrier. These plans would be informed by improved systems for collecting and interpreting surveillance and other safety data, along with assessments of risk derived from those data. To improve the quality and quantity of data available, inspectors were to be trained and socialized "to have respect for the importance of data quality," [184] airline data sources such as digital flight recorders would be exploited, and a "centralized information management function" would disseminate safety information and assist in the interpretation of safety data [185]. Moreover, the Review raised the prospect "for leveraging FAA inspector resources for carriers that can demonstrate superior safety practices such as internal self-audits that provide high quality safety data to the FAA." [186] The surveillance plans would also make more effective use of geographic inspectors, whose work plans for a given carrier would come from the office holding that carrier's certificate [187]. Finally, responses to findings, including follow-up inspections and enforcement proceedings, would be systematized to "maximize utilization of inspector and attorney resources for the greatest safety and efficiency." [188]

To bring the concept of targeted surveillance to a realizable plan for oversight improvement, AFS formed a Surveillance Improvement Process (SIP) team of inspectors, other AFS personnel, and safety specialists from Sandia National Laboratories. While citing as its mandate the 90-Day Safety Review recommendation on targeted surveillance, the SIP report expressed the problems with surveillance in somewhat different terms. It cited "a pronounced separation among the

functions of certification, surveillance, and enforcement," risk assessments that were "intuitive" rather than "analytical," "individualized and uncoordinated procedures for managing certificates," despite the ability of "capable and effective certificate managers … to assess the safety of their particular carriers," and "the difficulty of assessing the safety of the air carrier system as a whole or the relative safety of different carriers" [189].

The SIP team's proposed process formed the basis for the ATOS as it exists today. It included the same basic steps—System Configuration, Certificate Management, Surveillance Resource Management, Surveillance Implementation, Reporting, Evaluation, Analysis, and Implementation—that appear on the ATOS website as of early 2005.

The first step, and a cornerstone, of the Improved Surveillance Process (ISP) proposed by the team was System Configuration. Taking the view that the "FAA cannot realistically inspect enough … to achieve the desired safety level: safety must be inherent in the system," [190] the SIP team called for the application of analytic techniques, such as fault tree analysis of carrier and industry data to identify safety-critical aspects of the carrier's system, documenting how the air carrier assures it is operating safely, deriving safety performance measures and criteria, and establishing means for reflecting changes in the air carrier's operation into its certificate and surveillance. The System Configuration step also included creation of a Certificate Management Team (CMT) consisting of inspectors and supporting personnel responsible for surveillance of the carrier.

The second module of the ISP was termed Certificate Management, in which the CMT develops and executes a surveillance plan. This would involve combining "inputs from system and configuration with feedback from actual inspection activity … to produce a dynamically managed surveillance cycle plan." [191] The plan would identify all surveillance to be performed during the surveillance cycle, the tasking required to accomplish the surveillance, and the roles of CMT members in subsequent evaluation and analysis of the surveillance data. The plan would also consider the availability of trained and qualified personnel necessary for its execution.

The remaining six modules follow logically and predictably from the first two. In Surveillance Resource Management, the surveillance plan is translated into work assignments for appropriately trained individual CMT members, who then carry out their assignments in the Surveillance Implementation step. Then, in the Reporting module, inspectors prepare reports on the results of their surveillance, which are validated and quality assured by the FSDO before being uploaded into a national database. An additional level of validation and quality assurance is provided by the CMT in the Evaluation step. With the information thoroughly validated, the CMT moves to the Analysis phase where it uses the information to assess trends, exceedances, and accomplishment of the surveillance plan. The outcome of the analysis is a set of actions, which might include changes in carrier operations, modifications to the certificate or to the certificate management infrastructure, changes to the surveillance plan, policy changes, or enforcement actions [192]. These actions occur in the Implementation step, after which the entire eight-step cycle repeats itself.

AFS moved quickly to implement ATOS. In October 1998, just 15 months after the completion of the SIP report, ATOS was initiated at 10 of the nation's largest passenger air carriers. In theory, ATOS was, in the words of GAO, "largely responsive to past concerns raised about key aspects of FAA's aviation safety inspections and the usefulness of inspection data." [193] Following the SIP recommendations, each airline was assigned a team of inspectors, who developed comprehensive surveillance plans that established the priority and frequency of different inspection tasks based on carrier-specific data and information. The component inspections, however, were standardized, with each type of inspection structured around an inspection checklist that had to be completed, rather than a set of optional tasks that inspectors could choose to perform at their own discretion [194]. In addition to lending more structure and uniformity to inspections, the new approach encouraged the collection of higher-quality, more standardized surveillance data. This goal was also furthered by including personnel responsible for reviewing and analyzing the data on each ATOS inspection team. Finally, ATOS tightened the linkages between the inspectors' technical training and work assignments.

Nonetheless, shortcomings in both design and implementation of ATOS were widely observed. Many inspectors considered the inspection guidance to be unclear and vague, training to be too rushed and inadequate, and personnel assigned to inspection teams to be lacking in appropriate experience or inconveniently located. Work assignments to inspection team members, moreover, did not take adequate account of their other job responsibilities, such as demand work related to airline initiatives or, in the case of geographic inspectors, other inspection work assigned to them by their local offices. Nor were the assignments informed by knowledge of the time required for ATOS inspections. Finally, although data collection protocols were standardized under ATOS, this was done without adequate consideration of what data are needed for the oversight system to effectively monitor and improve air carrier safety. In the words of GAO: "Because FAA did not sufficiently analyze or list the data needed …, features that would maximize the usefulness of data for analysis and targeting were not built into the system." [195]

Three years later, a Department of Transportation Inspector General report on ATOS voiced additional complaints, while reiterating some of those stated by the GAO. The analysis and system configuration elements of the ATOS process were not yet fully developed; without these, neither surveillance planning nor the identification of actions needed to improve safety could be analytically based. Some 71 percent of inspectors considered the training to be inadequate, and the national ATOS program office had not provided the strong oversight necessary for consistent implementation [196]. As a result of the lack of training and analysis tools, "principal inspectors continue to *primarily* use their past experience to plan inspections and direct resources." [197] The problem of overly broad inspection checklist questions remained, while at the same time the structure of the checklists precluded the reporting of important findings if they did not fall within the scope of the preplanned inspection [198]. Most troublingly, the report found that "FAA inspectors are: (1) confused over how to conduct ATOS inspections; (2) unclear on the concepts of system safety and risk analysis; (3) frustrated by a perceived lack of management direction and support, and (4) concerned that ATOS does not give sufficient inspection coverage of air carrier operations." [199] This concern found its most pointed expression in the NTSB report on the crash of Alaska Airlines Flight 261, which cited deficient oversight, attributed by inspectors to the ATOS transition, as a contributing factor [200].

The ValuJet Flight 562 crash in 1996 also drew the attention of the aviation system to the oversight of third-party maintenance facilities (repair stations). Air carriers have used repair stations for some time, and the regulations that pertain to repair stations have not changed very much since 1962, but their use is more common now than it was in the 1960s, according to the GAO [201]. The ability of the oversight system to change as industry changes is a desirable attribute, and the difficulty of this change is one of the recurring themes in the history of the oversight system.

The FAA oversees the repair stations directly, and indirectly through the air carriers' audits of the stations, which is similar to a designee system or any oversight system in which surveillance is not performed directly by the regulator [202]. For example, a carrier needs to show that each of its contracted repair stations can perform the maintenance for which it is contracted [203]. This relationship leverages the FAA's resources and expands the coverage of the oversight system. But this arrangement has its own problems, including data sharing, underreporting, and data accuracy.

Another example of industry self-surveillance dates from even earlier. Since 1964, the FAA has required each air carrier to have a quality assurance program for its maintenance program (a Continuing Analysis and Surveillance System (CASS)) [204]. CASS is run by the individual carriers to monitor the effectiveness of their own maintenance programs. The FAA is responsible for ensuring that carriers use their CASS. Federal Aviation Regulations state that carriers must have a program, but the laws do not define how to assess the effectiveness of these programs. There is no formal way to know which CASS programs are most effective and which need improvement [205]. The consequence of this arrangement is that the AFS cannot use the carriers' own programs to monitor compliance with the regulations—it still needs to monitor the carriers' maintenance programs directly [206]. This is a potential problem when oversight is structured to rely on the carriers' own surveillance programs (the FAA stated that CASS programs are part of its collaborative approach to obtaining regulatory compliance) [207]. The structure of oversight becomes more indirect when carriers use their CASS to audit work performed by third parties.

Cooperation among stakeholders in the aviation system allows the FAA's oversight system to detect weaknesses in safety systems without direct surveillance. In 1998, the GAO reported that since 1990, the FAA has become more reliant on a cooperative approach to compliance and enforcement rather than on one that relies on punishment [208]. In 1990, Administrator Busey proposed the use of self-audit programs at air carriers. The Administrator said that the FAA would not penalize air carriers for findings discovered through the audit programs. In 1992, the Administrator proposed a similar system for aircraft manufacturers [209]. But self-audit programs were also an element of the Secretary's Task Force on the FAA Safety in 1975. In both cases, the FAA looked to industry to conduct self-monitoring and self-assessment.

2. EVALUATION AND ASSESSMENT OF THE OVERSIGHT SYSTEM.

The first eight decades (from the Air Mail Service of the early 1920s to the outsourcing problems of the 1990s) of federal involvement in the safety oversight system have been reviewed. The authors have only tangentially touched on the motivating question of evaluation and of how the

performance the oversight system was conceived and assessed over time. This section discusses that topic.

It is notable that while the oversight system has been the object of frequent tinkering and periodic overhauling, the assessment of its performance has received little explicit attention. While most, if not all, initiatives to change the system were based on perceived deficiencies, these perceptions have, for the most part, been divorced from any comprehensive normative framework or system of assessment. The only conspicuous exception is Quesada's four F's: that the oversight system should be Firm, Fair, Fast, and Factual. But Quesada's program was short-lived, and the four F's seems more a slogan than a framework. The most relevant information about oversight system evaluation is obtained not from these rare, explicit goal statements, but the beliefs and assumptions implicit in the behavior of decision makers and stakeholders.

It is obvious that from the very beginning, the fundamental purposes of the oversight system were to both promote and protect. The Air Mail Service of the 1920s demonstrated the possibility that an air transport system could be sufficiently safe that normal, risk-averse people could gain utility from it. The challenge was to port that system from its public-sector developers to private industry, where its commercial potential could be fully realized. The response to that challenge was the Kelley and Air Commerce Acts of the mid-1920s.

The level of safety achieved by the Air Mail System compared to the private sector commercial operations—a 60-fold reduction in fatality rates—was a remarkable achievement. Given the similarity of the underlying technology and operational characteristics, this comparison could be reasonably interpreted as the outcome of a natural experiment that revealed the safety payoff from rigorous pilot training and strict maintenance protocols. But these measures were expensive, and for the most part invisible to the customer. The temptation for a commercial operator to cut corners was obvious, and the need for government oversight to discourage this was self-evident. This was recognized by industry leaders as well as government policy makers. Once Congress recognized it as well, it passed the Air Commerce Act.

The question of whether—or to what degree—the safety oversight system yields measurable safety improvements has grown murkier over time. The relevance of the natural experiment of the 1920s has long since faded. Policy makers in the late 1930s came to recognize that gross accident statistics were no longer an appropriate barometer, at least when those statistics showed an adverse trend. Congressman Anderson's comparison of the upturn in accidents after the 1939 reorganization and the reduction in rainfall in Kansas after the relocation of the Weather Bureau is indicative of this.

Starting at about that time, accident investigations became a major source of evidence on the performance of the oversight system as a producer of safety. Beginning in 1938, such investigations were divested from the oversight organization, reducing the problem of conflict of interest and providing a credible means of determining whether a given crash was the outcome of a failure to follow safety rules, a shortcoming in the rules themselves, or some other cause. The lessons learned from accident investigations became a major impetus for change in the oversight system as well as in the rules that the system enforces. Often, when the accident investigation

identified shortcomings in oversight as a cause, this led to further investigations directed at the oversight system itself.

Given its two-fold mission, safety oversight performance could never be assessed on one dimension alone. From the outset, there was equal concern that the aviation industry not be stifled by excessive regulation, by overly stringent enforcement, or by lengthy waits for inspections. To deal with the first of these issues, the FAA has worked closely with industry to create regulations that have widespread support and has often postponed implementation deadlines to avoid undue disruption or high cost. With respect to enforcement, the agency has, for the most part, de-emphasized punishment in favor of educating violators and helping them to mend their ways. Only during the Quesada era, which featured more autocratic rulemaking and rigorous enforcement, did the agency stray significantly from this approach. The agency's hasty retreat in the face of industry protest makes this an exception that proves the rule. Finally, to keep up with ever-mounting volumes of oversight work, the FAA has shifted as much of that work as possible to industry, beginning with the first designee programs of the late 1930s. Implicit in this approach is another objective—to control the cost of the oversight program. The promise that, by spot-checking an army of industry-employed designees, the agency could leverage a modest work force to accomplish a much larger task has enticed agency officials for over half a century. While successful in many ways, the designee approach made the oversight system highly dependent on the support and cooperation of industry.

One way to conceptualize the evolution of the aviation safety oversight system is in terms of a classification of government agencies proposed by James Q. Wilson [210]. This simple yet elegant scheme identifies four types of agencies based on the answers to two questions:

> "Can the activities of their operators be observed? Can the results of their activities be observed? The first factor involves *outputs*—what the teachers, doctors, lawyers … do on a day-to-day basis. The second factor involves *outcomes*—how, if at all, the world changes because of their outputs." [211]

When the answer to both questions is yes, the agency is termed a production organization. Examples of such organizations are the U.S. Post Office and the Social Security Administration. The Post Office, for example, can observe what its letter sorters and mail carriers do and whether the mail delivery standards are being met. If outputs can be observed but outcomes cannot, Wilson terms the agency a procedural organization. Examples include mental hospitals, juvenile reformatories, and—more relevantly in this context—the Occupational Safety and Health Administration (OSHA), whose managers "know or can easily find out what their safety and health inspectors are doing, but only with great difficulty can they learn whether those activities have materially improved safety and health at the factories that they inspect." [212] Conversely, Wilson defines a craft agency as one that "consists of operators whose activities are hard to observe but whose outcomes are easy to evaluate." [213] Examples include soldiers during wartime whose commanders have only vague knowledge of their locations and activities but can readily learn whether they have won their engagements or Army Corps of Engineering field representatives who are "scarcely looked over and surveyed by … supervisors at all" [214] but whose outcomes—"whether the air base was built on time and within budget"—can be readily evaluated [215]. Finally, in some organizations it is difficult to observe either what the operators

do or what outcomes they produce. Wilson calls these coping organizations, citing as examples schools, police forces, and even the diplomatic corps [216].

Wilson does not specifically consider aviation safety oversight programs within government agencies, but presumably these programs can be described with a similar logic because organization matters for both agencies and programs. The FAA may best be described as a production agency, but like OSHA, safety oversight programs fit in the procedural organization category. While supervisors cannot closely monitor an inspectors' every move, they can track their surveillance and certification activities. On the other hand, how the work of the FAA inspectors influences aviation safety, such as how the work of OSHA inspectors affects workplace safety, is now and has always been difficult to know. Wilson observes that in such organizations, because management "cannot justify on the grounds of results leaving operators alone to run things as they see fit," it becomes means-oriented: "How operators go about their jobs is more important than whether doing those jobs produces the desired outcomes," and standard operating procedures thus become pervasive [217]. Recent developments in the oversight system, including the National Program Guidelines, which specifies what inspections must be performed, to ATOS, which specifies how they will be performed, point to an oversight system that is moving in a procedural direction.

These recent developments suggest that aviation safety oversight has not always been a procedural activity. Indeed, the ability to observe both outputs and outcomes has changed over time. Information and communications technology has increased the ability of AFS managers to monitor the activities of its far-flung inspector work force. This would suggest that aviation oversight has evolved from a coping organization to a procedural one. Inspectors in earlier times were more like solitary policemen patrolling their beats (a police agency being a prototypical coping organization) than members of the highly orchestrated Certificate Management Teams created under ATOS. Wilson observes that because neither outputs nor outcomes are observable, the management of coping agencies is especially difficult and prone to conflict between managers and operators. Managers must "cope with complaints from politically influential constituencies" but "do not know with confidence what behavior occurred and cannot show with confidence what behavior resulted." [218] Such complaints have not been lacking: over the years there has been a steam of well-publicized incidents of misbehavior on the part of individual inspectors, ranging from surliness, to abuse of discretion, to blatant corruption. The repeated management upheavals and reorganizations that have occurred in the aviation oversight system for much of its history may reflect the strains of this difficult position. Also consistent with a coping organization is the tendency of management to "focus their efforts on the most easily measured activities of their operators" and of the operators to respond through a combination of conformance, subversion, or some balance "generating enough stats to keep management happy while they get on with their own definition of what constitutes good work." [219]

But arguably, there has also been a trend in the observability of the outcomes of inspector work. As previously noted, for most of its history the oversight system has operated in a climate of rapidly declining accident rates. To some degree, this made the oversight system more like a craft organization. In this regard, safety oversight was part of an army that was winning the war against the death and destruction caused by civil aviation accidents. The analogy is not perfect

because that army contained many other elements—airframe and avionics manufacturers, airlines, airmen, and air traffic control—that also played large roles. But as a political matter, managers of the oversight system could cite the favorable trends as a way of fending off criticism of how the system operated: "complaints … can be partially deflected when the manager can argue that the outcomes achieved justified the action in question." [220] As important as the declining rates was, the comparatively large number of accidents, the investigations of which would sometimes reveal oversight deficiencies that managers could move to eliminate. As the commercial airline safety record has approached perfection, the ability of oversight managers to rely on either trends or accidents for outcome information has also declined.

As an organizational entity, the safety oversight system has evolved from a hybrid craft/coping agency to a procedural one. That evolution is far from complete. Many inspectors still believe, and perhaps rightly, that "the good inspector," like the "good cop," combines an ineffable mix of patience, toughness, reciprocity, responsiveness, forbearance, and bargaining skill whose job should not be standardized and whose output cannot be measured [221]. Others see the promise that the same technologies that enable aviation oversight to become a procedural organization, may, by establishing quantitative links between hazards and accidents, allow it to become, like the Post Office, a production one. But for the moment, it remains in the nature of the safety oversight task that adversity is more conspicuous than accomplishment. The oversight system is noticed when it rejects a license application, punishes an airline through fines or decertification, or allows an unairworthy aircraft to fly, which resulted in a crash. Prevented accidents and incidents, in contrast, never make the news. Now, as in 1928, those engaged in aviation safety oversight, "are confronted with an appalling job."

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