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History of Aircraft Dispatchers in the United States: Improving Safety

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The aircraft dispatcher is an indispensable member of United States airline operations. The airline industry advanced from early attempts to transport mail and occasional passengers on a scheduled basis into a highly complex, tightly regulated, extremely safe means of transportation. Dispatchers have a key role that has expanded over time both in its scope and in its authority. The concept of operational control began with the desire to improve safety and enhance situational awareness for air carriers. Beginning with the earliest references to dispatchers, this paper explores the history of dispatchers from 1929 to the 1970s, operational control in the United States, and associated safety improvements. Drawing from both primary sources in the form of original aviation trade journals, aircraft accident reports, and books reviewing airline history, this paper examines how the dispatch profession has evolved and significantly enhanced aviation safety.

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Aircraft dispatchers have a crucial role in ensuring the safety of airline operations in the United States. The history of aircraft dispatchers and the changing role of dispatchers is not well documented, yet today, the United States airline industry relies heavily on the dispatcher's role in flight planning, flight following, and weather monitoring. After the airline industry established the dispatch profession, the operational control concept was developed. This concept employed both a pilot and a dispatcher with operational control over each flight. Utilizing a comprehensive review of books covering the United States airline history, aircraft accident and incident reports, and primary source aviation trade publications, this paper examines the crucial role of the aircraft dispatcher in airline operations from 1929 to the 1970s. This study begins with a historical overview of aircraft dispatchers and documents the establishment of the aircraft dispatcher certificate. Examining a series of accidents and incidents related to operational control, aircraft performance and loading, and other dispatch-related accidents demonstrates the critical role of the aircraft dispatcher in airline safety in the United States. Many accidents were examined during this research project, but ultimately, accidents with dispatch-related causes that improved aviation safety were chosen for inclusion in this paper.

Pre-Airline Dispatching

The emphasis on maintaining control, monitoring transportation progress, and issuing orders to moving vehicles originated with the railroad industry (Caisse, 2015). After the invention of the telegraph in 1830, railroads established lines along their tracks to pass messages and monitor train progress (Hardin, 2006, p.1). According to Hardin (2006), railroads recruited "thousands of young men for the lines – as young as 16" (p. 2). The station telegraph operator monitored and ordered train movements, handling railroad traffic as his primary duty. "Knowing the exact position of every train at all times was paramount in preventing a deadly train wreck or mishap" (Harden, 2006, p. 2). To maintain safety in railroad transportation, operators closely followed traffic conditions and traffic on the tracks.

Early Aircraft Dispatchers

Lawrence Sperry's October 1916 experiment explored the link between using Morse code and communication with an aircraft in flight. *Aviation and Aeronautical Engineering* (1916a) documented the use of three searchlights attached to the leading edge of the upper wing of the biplane so that "Morse code can also be used with these searchlights…which can be operated like a telegraph key" (p. 163). *Aviation and Aeronautical Engineering* (1916b) reported another test that successfully used a "wireless telegraph and telephone set invented by Dr. Lee de Forest for application to aeroplanes" (p. 197) at the United States Army Aviation Station on Long Island, New York. Less than three years later, a detailed article entitled "Wireless Telegraphy Applied to Aviation" by W. Knight (1919) appeared in *Aviation and Aeronautical Engineering* (pp. 572-575). Knight's article served to endorse the absolute necessity of positive communication with aircraft in flight. This need to communicate became especially important as Army pilots began flying mail in 1918 (Stroud, 1977, p. 235). By 1930, Boeing Air Transport pilots made required position reports to ground stations every 20 minutes through radiotelephone and received updated weather information (Garvey & Fisher, 2002, p. 76).

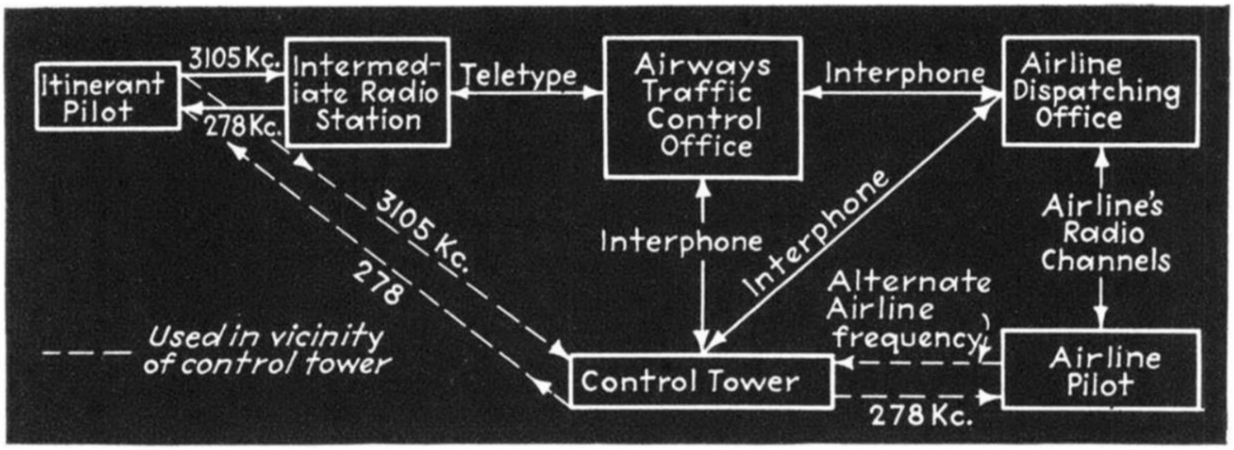
In 1929, the term "dispatcher" first appeared in advertisements in aviation trade publications in conjunction with more sophisticated means of communicating with aircraft. Advertisements in *Aviation* (1929) promoted the Western Electric two-way radio telephone system that "permits the dispatcher at the airport to talk at will with pilots in flight, advising them and receiving constant reports of their progress" (p. 4). In 1930, Boeing Air Transport installed the same system in its aircraft and 18 ground stations. Advertising text for Western Electric Aviation Communication Systems referred to Boeing Air Transport pilots as "always in touch with dispatchers and weather observers along their routes. Reports on weather and field conditions, guiding radio beacon signals, or instructions come in clearly, helping pilots to bring their ships through on time" ("Boeing Installs," 1930, p. 58). This description of the dispatcher includes similar responsibilities of modern dispatchers, which include issuing necessary information for the safety of flight (Holt & Poynor, 2016, p. 203) and maintaining communications with each flight (Holt & Poynor, 2016, p. 15). Willets (1931) noted that "the highest degree of reliability and safety can only be achieved with this mode of transportation when instantaneous communication with ground is available to the pilot throughout the flight" (p. 9).

The link between railroad telegraphers and early dispatchers is easy to understand, given how railroad telegraphers controlled train movements and monitored track conditions. Eventually, the dispatcher became an air traffic controller at busy airports. The March 1933 issue of *Aviation* documented dispatchers utilizing a light signal gun to aim a red or green beam at an airplane at "many airports where traffic is heavy" (p. 100). Another article in the August 1933 issue of *Aviation* described a tower at Allegheny County Airport in Pittsburgh where a dispatcher had a desk with:

> …almost finger-tip control of the arrival and departure of planes…Incoming and departing planes receive authorization to land or to take-off from a signal "gun"…All boundary, obstruction, and floodlights are also controlled from the dispatch board in the dispatcher's tower. (p. 240)

The role of dispatchers as air traffic controllers ended in 1935 when a new inter-airline agreement governed air traffic. This agreement included an experimental center for traffic control staffed by dispatchers from various airlines (Professional Airline Flight Control Association [PAFCA], n.d.). A July 1936 article by Jerome Lederer in *Aviation* described this system of Airway Traffic Control Offices (ATCO) controlling traffic separately from the airlines themselves (pp. 22-23). The system initially controlled traffic at Newark, and it required periodic communications of each flight's position between pilots and associated airline dispatching offices. The dispatcher communicated through an interphone system to Newark ATCO when the flight was over the last fix nearest the airport. If the flight was not going to be cleared to land imminently, ATCO informed the dispatcher and the dispatcher notified the pilot, who held the present position until cleared to continue. When each flight reported over the inner radio marker, the dispatcher notified ATCO who cleared the flight to proceed from the inner marker to the terminal. The pilot then contacted the control tower and proceeded to land. At that time, Newark had 64 closely spaced arrivals and departures per day. This generated concern for safety with the number of airplanes converging on busier airports (Lederer, 1936, pp. 22-23).

Figure 1
Relationship of Dispatcher and ATCO



Note. From “Go Ahead, Newark,” by J. Lederer, 1936, Aviation, 35, p. 22.

Dispatchers had the best interests of their respective airlines in mind, and each airline wanted its flights to arrive and depart on schedule. Obviously, conflicts of interest at busy airports occurred. The Bureau of Air Commerce established a permanent solution to separate the flight planning, flight following, and meteorology functions from controlling when airplanes arrived and departed. The ATCO solution previously described was not ideal; it involved direct communication and coordination between the aircraft dispatcher, the pilots, and the ATCO office.

On June 6, 1937, the Bureau of Air Commerce separated the dispatch and air traffic control functions by assuming control of airway traffic control centers (PAFCA, n.d.). According to Caisse (2015), the Bureau of Air Commerce certified several hundred existing airline dispatchers together as the Bureau created the new aircraft dispatcher certificate, grandfathering in these formerly uncertified airline employees.

The first documented educational program for training aircraft dispatchers appeared in the October 1936 issue of *Aviation*. The subjects covered included meteorology, dispatch practice, and airline operations. The course took 18 months to complete and required two years of college or nine months of accredited engineering college coursework prior to enrolling (p. 66). The 1947 vocational film *Your Life Work Series: Air Transportation* called the dispatcher a “flight superintendent.” The film describes a flight superintendent’s role in flight operations:

> He is the man who decides whether the planes will fly or not. He releases all planes on his division, follows their progress in the air, and keeps the captains…advised of conditions affecting their flight…He coordinates all flight operations to achieve these objectives: safe, swift, and dependable air transportation. (Twogood, 1947)

The flight superintendent position required a pilot certificate and a dispatcher certificate issued by the Civil Aeronautics Authority (Twogood, 1947).

Early Accident Rates

Despite the early airlines' best attempts to maintain an image of safe and reliable transportation, many accidents occurred. The public perceived aviation as a dangerous means of transportation. Rumerman (n.d.) states that in 1932, a $5,000 insurance policy for an airplane trip cost two dollars, while the same policy for a railroad trip cost just 25 cents. American Airlines President C.R. Smith authored a 1937 advertisement entitled, "Why Dodge This Question: Afraid to Fly?" (Allen, 1981, p. 98). This advertisement came after a series of accidents in the mid-1930s, several of which helped redefine the role of the aircraft dispatcher.

Increased passenger traffic led to more flights, and the increase in flights caused a corresponding increase in accidents. Sterling (1969) notes that the 1932 airline fatality rate was extreme, at 14.96 deaths for every 100 million passenger miles flown (p. 43). Between 1930 and 1937, 45 airline accidents occurred in the United States (PlaneCrashInfo.com, n.d.). This number included only the accidents involving three or more people; even more airline accidents involving only one or two people occurred during this period. The public viewed flying as a dangerous means of transportation; more than four significant accidents occurred each year during this period. Specific accident causes were not determined before mid-1934, but accidents were caused by maintenance issues, pilot errors, weather, and dispatcher errors (United States Department of Transportation, 2023).

Figure 2
Number of Airline Accidents Involving three or More Persons, Sorted by Year

Year	Number of accidents
1930	4
1931	4
1932	4
1933	5
1934	5
1935	7
1936	11
1937	5
Total	45

American Airlines Flight 166

A series of high-profile accidents in the mid-1930s led to formalized certification of aircraft dispatchers. The first of these accidents involved a Curtiss-Wright T-32 Condor II, NC-12363, operating as American Airlines flight 166 on December 28, 1934. Newman (2008) states that brothers Ernie and Dale Dryer crewed the flight. They were former barnstormers and friends of Amelia Earhart and Charles Lindbergh. Flight 166's trip sequence went from Boston to Albany, Syracuse, Cleveland, and ultimately, Chicago. One revenue-generating passenger and one dead-heading company pilot boarded at Boston, and ramp agents loaded the airplane with mail and packages (Newman, 2008).

At Syracuse, Ernie Dryer called the American Airlines dispatcher based in Albany. The dispatcher briefed Dryer about a blizzard to the west over Lake Erie and Cleveland. The dispatcher cleared the flight to return to Albany, but neither the dispatcher nor the crew realized that the winter storm had moved north. About 35 minutes into the flight, the aircraft lost its radio antenna due to ice buildup, and the right engine started to lose power due to excessive carburetor ice. The Condor II had no wing deicing system, but it did have propeller deicing capability. To manually de-ice the aircraft, the crew hand-pumped alcohol into the propellers. Chunks of ice slid off the propellers and slapped the fabric-covered fuselage. With ice building up on the wings, the aircraft crashed into a grove of trees, its impact cushioned by branches (Newman, 2008).

Newman's (2008) account describes the overnight survival of crew and passengers. By morning, they used the remaining aircraft battery power and a repaired aircraft radio to inform the dispatcher at Albany that they were alive but required immediate assistance. In the late afternoon, a search aircraft spotted the crash site. Dale Dryer suffered a broken jaw; no one else was injured more seriously (Newman, 2008). The Bureau of Air Commerce determined the probable cause to be "the failure of the company to have on duty in the Division Control Office a competent dispatcher in charge of flight control" (Aviation Safety Network, 2018). While the dispatcher did clear the flight to return to Albany directly into the path of a blizzard, it is doubtful as to whether the dispatcher intentionally sent the flight into the storm. More likely, weather reporting and forecasting in 1934 caused an erroneous understanding of the storm's position. Less than six months later, another weather-related accident sparked public outcry and generated a United States Senate investigation (Serling, 1983, p. 55).

TWA Flight 6 – The Bronson Cutting Accident

Serling's (1983) narrative of Transcontinental & Western Airlines (TWA) flight 6 discusses similarities with the American Airlines flight 166 accident, including weather reporting and forecasting errors and radio communication issues (p. 55). This first fatal crash of the Douglas DC-2 occurred on May 6, 1935, near Kirksville, Missouri. Five of the thirteen people on board died (Rimson, 1998). One of the fatalities was Senator Bronson Cutting of New Mexico (Serling, 1983, p. 55). Had it not been for Senator Cutting's presence on the flight, the accident would probably have been forgotten. The flight consisted of two airplanes flying the scheduled route together. The first flight departed approximately 30 minutes prior to the second (Serling, 1983, p. 54).

Senator Cutting boarded the second airplane of the flight in Albuquerque, heading for Kansas City. The DC-2's faulty radio transmitter received only the daytime company frequency, but the flight departed at night. The flight's captain, Harvey Bolton, elected to depart because Weather Bureau reports called for clear skies along the route. The radio's continual issues made it impossible for the flight to respond to the dispatcher, who finally told Captain Bolton to continue to Kansas City as the first airplane of the flight had just landed there despite poor visibility and low ceilings. In the 30 minutes it took for the second airplane to get to Kansas City, the weather dropped below landing minimums. Once the flight arrived in Kansas City, it had less than 45 minutes of fuel on board. TWA's worried meteorologist phoned a nearby oil refinery to ask them to "ignite extra gas so Bolton might spot the flames" (Serling, 1983, p. 54).

The TWA dispatcher, Ted Haueter, checked the weather at Kirksville, an emergency airport 120 miles northwest of Kansas City. Kirksville was below landing minimums, so Haueter advised flight 6 to proceed to Burlington, Iowa, the next available airport. Unfortunately, Burlington was 250 miles away, and flight 6 did not have enough fuel left. Captain Bolton headed toward Kirksville and attempted to descend through the overcast to make visual contact with the ground. Visual contact occurred only a few feet from the ground, and the DC-2 slammed into a 60-foot embankment and immediately flipped (Serling, 1983, p. 54).

Serling (1983) describes the chaotic investigations after the accident:

> The Department of Commerce…was literally investigating itself and proceeded to lay most of the blame on everybody but itself…The only criticism levied against the government was the Weather Bureau's inaccurate forecast and its failure to advise Flight 6 that Kansas City minimums had dropped below legal limits. (p. 55)

"Contributory causes" cited by the Board included "failure of TWA ground personnel at Kansas City to expeditiously redispatch the airplane to a field where better weather existed when it became apparent that the ceiling at Kansas City was dropping" (Rimson, 1998). Rimson (1998) states that TWA soon rebutted the findings of the Department of Commerce Investigation Board, and Senate hearings included testimony from R. W. Schroeder, Chief of the Air Line Inspection Service. Schroeder testified:

> …the accident started to happen when the pilot, still only a half hour out of Wichita enroute to Kansas City and knowing he was without two-way radio communication, first encountered instrument meteorological conditions. Yet both TWA's Captain and dispatcher sanctioned continuation into the weather and a fruitless attempt to land at Kansas City before attempting to continue on to a suitable alternate landing field. (Rimson, 1998)

The major outcome was the Civil Aeronautics Act of 1938, which established an independent Air Safety Board for accident investigation and an independent Civil Aeronautics Authority (Serling, 1983, p. 55). The accident highlighted the importance of better weather forecasting, resulting in more timely and accurate information flowing between both pilots and dispatchers.

The accident motivated TWA to improve its dispatch operations, and its president, Jack Frye, did not punish dispatcher Haueter, who allowed flight 6 to circle at Kansas City while wasting fuel. Instead, Frye promoted Haueter to flight superintendent (Serling, 1983, pp. 55-56). *Aviation* described TWA's dispatch system in a fascinating article, "Flying with One Foot on the Ground," published in August 1937. It opens with a story of two pilots, "Young Fellow" and "Old Timer." In a fairytale-like fashion, the article tells the story of the Bronson Cutting accident in a lighthearted, de-identified narrative. The story ends with "Young Fellow" making good decisions, having plenty of fuel, and heading toward a pre-determined alternate airport. "Old

Timer" lands at an emergency field after running low on fuel, but he still gets his passengers safely on the ground ("Flying with One," 1937, pp. 24-25). The article states that after this "incident," which is clearly a thinly veiled account of TWA flight 6, TWA President Jack Frye:

> made up his mind then and there that no pilot in the future would take off with a load of passengers without knowing exactly how he was going to get to his destination and what he would do if that destination was unavailable. Thus was born TWA's Flight Plan. ("Flying with One," 1937, p. 25)

TWA organized a flight control and navigation department. They equipped each pilot with a kit including routing information, charts, graphs, tables, flight computers, and a flight plan. Pilots made required checks of actual fuel burn at various checkpoints along the route versus planned fuel burn. The airline designated specific alternate airports in case the weather was not as forecasted and planned a direction to fly in case of total radio failure ("Flying with One," 1937, p. 25). Since the article only discusses TWA, it is unclear if other airlines adopted these policies prior to 1937. The article frames the new planning as innovative. It is plausible that this was the first major airline application of proactive fuel management combined with the development of contingency planning.

TWA made "a dozen or so" of the airline's best pilots into chief dispatchers. Many of its early dispatchers were "youngsters who had actually come along from clerical or other non-flying positions…[and] didn't know what they were talking about, or at least did not know how to interpret properly the information that was given to them" ("Flying with One," 1937, p. 72). Jack Frye was "among the first" to view the dispatcher as an additional crewmember ("Flying with One," 1937, p. 72). The modern aircraft dispatcher's role is remarkably like the article's description of TWA's aircraft dispatchers in 1937:

> A properly trained dispatcher, sitting apart from the immediate stress and strain of flying the airplane and with all possible forms of information at his disposal, has an opportunity to sit down and figure things out in a way that is not possible for the pilot with his many flying duties. Thus, the old joke about flying with one foot on the ground could become an accomplished fact. But the foot-on-the-ground must have the complete confidence of his flying crews. ("Flying with One," 1937, p. 72)

Clearly, the Bronson Cutting accident caused TWA to elevate the role of the dispatcher to that of a qualified and trusted ground-based crewmember. This concept is paramount to improved safety through operational control.

Operational Control

According to 14 CFR §1.1, operational control means "the exercise of authority over initiating, conducting, and terminating a flight." Holt and Poyner (2016) state, "Someone other than the pilot-in-command is involved in the decision-making as to whether a flight starts, how it is conducted, and how and where it terminates" (p. 42). An October 13, 1937 paper by Larry C. Fritz of TWA outlined the earliest record of this type of control:

> The pilot has decided whether the flight can be made with absolute safety, and if the flight dispatcher is of the same opinion, plans can be made for the flight…If [the pilot] is in doubt as to the safety of the flight, he may telephone the flight dispatcher and discuss the flight with him prior to making his decision. Thus, he has checked his own decision at least twice with his consultation with a meteorologist and flight dispatcher…The pilot reports any variation from normal routine in flight, and if the dispatcher believes a departure from the calculated flight plan is advantageous, such as landing at an intermediate field, he issues orders for the pilot to land…the decision of the pilot and dispatcher are identical. Their first consideration is the safety of flight. (pp. 279-281)

This new concept of operational control meant that the pilot-in-command was no longer the only authority on the operation of each flight. Through operational control, the dispatcher's authority became equal to the pilot's authority. By 1940, American Airlines' operational control policy required "the captain and the flight superintendent on duty…be in complete agreement regarding the procedure of each trip before an airliner can take off. Either man can cancel a flight on his single authority" (Gann, 1940, p. 88).

Although airlines introduced the concept of operational control in 1937, putting operational control into practice rested in the hands of dispatchers and flight crews. Through several additional accidents, airlines learned the necessity of establishing procedures to incorporate operational control.

United Air Lines Flight 6

On November 29, 1938, a DC-3 operating as United Air Lines flight 6 departed from Medford, Oregon, bound for Oakland, California. The flight landed in the Pacific Ocean near Point Reyes after complete fuel exhaustion (Civil Aeronautics Authority [CAA], 1939, p. 1).

The Oakland-based dispatcher initially concurred with the U.S. Weather Bureau forecaster's opinion that the flight should not be dispatched from Medford to Oakland due to poor weather. After further consideration and a three-way telephone conversation with Captain Charles Stead and the Medford station manager, Captain Stead, and the dispatcher agreed that the flight could be dispatched. The flight departed Medford just after midnight, estimating arrival at 2:14 AM (CAA, 1939, pp. 6-7).

Because of enroute icing conditions and interference from other radio range stations, the crew could not hear radio range beacons used for enroute navigation. The crew attempted and failed multiple times to establish their position. By 3:17 AM, the crew managed to intercept the Oakland radio range, at which time it was already over an hour overdue. At 4:08 AM, Captain Stead estimated fuel remaining at only 60 gallons. The crew still did not know their exact position. Captain Stead descended through the clouds, hoping he was over the water, and sighted a ship and the lighthouse at Point Reyes at 5:03 AM. The flight ran out of options and fuel, over the water at 5:25 AM (CAA, 1939, pp. 8-10).

The aircraft mostly survived the ditching, and the crew and passengers climbed onto the roof of the aircraft through an emergency hatch. Initially, "the aircraft rode the swells easily"

(CAA, 1939, p. 10). Captain Stead and one passenger survived the ordeal, but First Officer Lloyd Jones, Stewardess Frona Clay, and three passengers survived the ditching yet drowned after the fuselage broke apart on the rocky shoreline (CAA, 1939, p. 1).

The flight's first dispatcher, Thomas Van Sciever, cleared the flight from Medford to Oakland and went off duty at midnight. He was relieved by dispatcher Philip Showalter. Although communication logs showed that Showalter knew flight 6 had difficulty hearing Oakland radio range, these logs showed he did not attempt to determine the amount of fuel remaining on the flight until an hour after the flight was scheduled to arrive in Oakland. At 4:10 AM, Showalter received the following communication from Captain Stead:

> OK, I have been over 50 minutes from there, left of range???? (static) am 30 degrees off in my computations. There must be something wrong with the range. I have 60 gallons of gas, and I am (descending). Don't know exactly where I am???? (static terrible) I figure I should be over now. There must be something wrong with the range. I am going to come down slowly. (CAA, 1939, p. 13)

Showalter belatedly suggested Captain Stead reduce power to conserve fuel. It took Captain Stead's panicked communication at 4:10 AM to motivate a flurry of dispatch activity. Showalter finally began emergency activities nearly two hours after the flight's scheduled arrival time (CAA, 1939, pp. 11-12).

The *Journal of Air Law and Commerce* (1939) published CAB safety recommendations resulting from the investigation. Dispatch-related recommendations included:

1. Establishing a clear definition of an emergency condition and duties and responsibilities of personnel involved.
2. Requiring the dispatcher responsible for each flight to designate its minimum fuel requirement.
3. Increasing minimum competency requirements for dispatchers.
4. Defining duties and responsibilities of air carrier dispatchers.
5. Prohibiting dispatching of scheduled air carrier aircraft in flight by anyone not holding an Air Carrier Dispatcher Certificate of Competency.
6. Requiring dispatchers to be more thoroughly tested upon applying for an Air Carrier Dispatcher Certificate of Competency.
7. Requiring a standardized flight plan format, a standardized navigation log including fuel consumption calculations, and standardized position reports.
8. Requiring a standardized minimum training program, including both pilots and dispatchers. (pp. 225-227)

These recommendations resulted in major improvements to the dispatcher's role in exercising operational control authority. United Air Lines flight 6 demonstrated that, in general, dispatchers did not quickly recognize emergencies and act to assist flight crews. Inadequate emergency procedures existed for dispatchers to follow.

Operational Control Accidents of the 1940s

Despite these recommendations, accidents related to dispatchers and operational control continued. On November 4, 1940, a United Air Lines DC-3 crashed near Centerville, Utah, while on approach to Salt Lake City, Utah. The crew descended into a mountain due to the airport's radio range station malfunction and static electricity caused by St. Elmo's fire impeding dispatcher communications and radio range station reception. (Civil Aeronautics Board [CAB], n.d., pp. 111-112) After this accident, the CAB (n.d.) enacted regulations to:

> …authorize a dispatcher in charge of a flight to direct it to an alternate or take other indicated action in the event that his judgment leads him to believe that the flight cannot proceed with safety in accordance with its original clearance. This power of the dispatcher would be subject to the authority which is vested in the pilot to depart from regulation or from company policy when, in his judgement, an emergency then confronting him requires it. (pp. 119-121)

Even today, operational control and dispatcher emergency authority are key safety concepts used in airline operations.

To maintain adequate supervision of assigned flights, a dispatcher must be assigned a reasonable number of flights. Civil Air Regulations in 1940 required air carriers to "provide an adequate number of certificated dispatchers…located at such points as may be deemed necessary by the Administrator to ensure the safe operation of the air carrier" (CAB, 1941, p. 18). The loss of Eastern Air Lines flight 14 demonstrated that scheduled air carriers of the 1940s often did not employ enough qualified dispatchers to exercise operational control over all flights.

On April 3, 1941, flight 14 flew into severe turbulence in a squall line and crashed near Vero Beach, Florida (CAB, 1941, p. 22). Eastern operated a dispatch office in New York and relied on ground transportation agents in Florida to facilitate local flight communications (CAB, 1941, pp. 3-5). Eastern flight 10, flying nearby, told the transportation agent to warn flight 14 to stay out of the area due to severe turbulence. The transportation agent, who was not a dispatcher, told flight 14 to "stand by until [trip 10] is in the clear" (CAB, 1941, p. 5). The transportation agent did not communicate the existence of hazardous turbulence to flight 14. Flight 14 entered the area and was buffeted by updrafts, downdrafts, and rotational winds. The crew lost control and crashed into a field. Everyone on board survived, although 13 occupants sustained serious injuries. The CAB (1941) concluded that the accident was avoidable had Eastern Air Lines provided sufficient dispatch centers and qualified dispatchers to facilitate current weather reports to enroute flights (pp. 21-22). Two of the CAB's findings were directed at operational control functions:

> The company transportation agent at West Palm Beach did not relay to [flight] 14 a verbatim report of the weather conditions that [flight] 10 reported at 8:32 AM.
>
> Eastern did not provide an adequate dispatching system together with a trained number of certificated dispatchers on Route 6 so that aircraft could be informed of changing flight conditions as they progressed along the airway. The distance between New York and

> Miami is about 1,250 miles, and it was not possible for the dispatcher stationed at La Guardia Field to maintain adequate supervision and control over the numerous aircraft simultaneously in flight and nominally under his supervision. (pp. 21-22)

Shortly after this accident, Eastern established additional dispatch offices in Miami and Atlanta (CAB, 1941, p. 23).

Other dispatch-related accidents of the decade included Eastern Air Lines flight 14 (December 30, 1945, unrelated to the previous flight 14 from 1941) and American Airlines flight 9 (February 23, 1945). Both flights suffered from poor preflight planning by dispatchers. The dispatcher of Eastern flight 14 also failed to keep the crew informed of weather trends at both designated alternate airports (CAB, 1946b, p. 9). American flight 9's dispatcher approved the captain's plan to fly at night under visual flight rules at an altitude lower than that required for the terrain along the route of flight. The CAB (1946a) cited "a general laxity in dispatching and flight supervision and a need for continued training and checking of pilots in proper flight planning" (p. 3). The CAB (1946a) chastised the Civil Aeronautics Authority in its report for not maintaining adequate oversight of American Airlines' dispatching procedures (p. 4).

Non-Scheduled Air Carriers and Lack of Dispatchers

All scheduled air carriers operated under Certificates of Public Convenience and Necessity, and the CAB created this requirement to ensure safe operations (Stringer, 2015). The CAB required airlines to employ adequate numbers of dispatchers. The CAB checked this through operational oversight. But after World War II ended, many enterprising pilots started "non-scheduled" operations, carrying passengers on popular routes, with very little CAB oversight. According to Stringer (2015), newly formed "un-certificated" supplemental operators took advantage of a loophole allowing operations as non-scheduled charter flights without the requirement to obtain a Certificate of Public Convenience and Necessity.

> In 1946, all companies employing large transport aircraft in irregular service were informed they would be subjected to a safety inspection in order to obtain a letter of registration identifying them as an approved large irregular carrier. The letter of registration was not the Certificate of Public Convenience, and Necessity issued to the scheduled airlines but a document verifying that the company was registered with the CAB and in compliance with safety regulations. The Civil Aeronautics Administration (CAA)…initiated the carrier examinations but did not have enough inspectors to accomplish the job quickly. Meanwhile, the non-skeds [*sic*] that were already operating in August 1946 were allowed to continue operating until the CAA could get around to inspecting them. (Stringer, 2015)

To save costs and simplify operations, non-scheduled operators did not employ dispatchers. They relied on flight crews to perform all preflight planning and operational oversight. A series of accidents resulted from this chaotic environment. These accidents demonstrated the crucial role of dispatchers in facilitating safe operations.

On September 5, 1946, a Trans-Luxury Airlines DC-3 crashed near Elko, Nevada. In its accident report, the CAB (1946c) described the crew's planned route from Cheyenne, Wyoming, to Reno, Nevada, with an alternate of Sacramento, California (pp. 7-8). This plan was not feasible at the altitude filed with the available fuel onboard (CAB, 1946c, pp. 7-8). The flight crew landed to refuel at Elko and flew an approach in ground fog, continuing below authorized minimums hitting the top of a ridge. The CAB (1946c) cited the lack of dispatch facilities as a contributory cause of the accident (pp. 9-10). The crew could not access any weather observer at Elko or a dispatcher to designate a refueling airport with better weather.

Accidents involving non-scheduled supplemental air carriers continued through the 1940s and 1950s. None of these air carriers utilized dispatchers. Flight crews alone exercised operational control. These four accidents, plus the Trans-Luxury Airlines accident, resulted in 67 fatalities, all of which could have been avoided with adequate dispatch oversight and operational control.

Figure 3
Non-Scheduled Air Carrier Accidents, 1940s-1950s

Date	Operator	Dispatch-related cause(s)	Fatalities
September 5, 1946	Trans-Luxury Airlines	Inadequate preflight planning, lack of operational oversight while enroute	21
August 15, 1949	Transocean Air Lines	Fuel exhaustion due to lack of adequate preflight planning	8
May 27, 1950	Regina Cargo Airlines	Improper loading over maximum gross weight, no flight manifest	2
December 29, 1951	Continental Charters	Failure to obtain preflight weather information and inadequate preflight planning	26
December 22, 1954	Johnson Flying Service	Fuel exhaustion due to lack of adequate preflight planning	10
			67

In 1963, Harvard Law Review documented safety issues at non-scheduled supplemental air carriers (p. 1459). Between 1960 and 1961, seven accidents resulted in the deaths of 255 people (Harvard Law Review, 1963, p. 1459). The 1960 crash of an Arctic-Pacific C-46F killed 20 members of a college football team during takeoff in near zero visibility. The aircraft was over 2,000 pounds in excess of its maximum gross weight ("CAB Cites Early Liftoff," 1962, p.79). Lack of operational control, in addition to flight planning errors, contributed significantly. Just over a year later, the crash of an Imperial Airlines Lockheed Constellation in Richmond, Virginia, killed 74 army recruits. The crew's lack of training and systems knowledge resulted in the loss of power in three of the four engines (CAB, 1962, p. 1). Harvard Law Review reported that these two crashes caused "a national furor." A subsequent congressional investigation concluded that more regulation by the newly created Federal Aviation Agency (FAA) should result in safer operations for non-scheduled supplemental air carriers (Harvard Law Review, 1963, p. 1460). On August 22, 1962, the FAA proposed regulations adding flight following systems for these carriers "to maintain better operational control of their aircraft and thus conduct safer operations" (p. 3).

The FAA revised Part 42 of the Civil Air Regulations on July 8, 1963, with an effective implementation date of November 11, 1963. The revision included rules for the certification and operation of non-scheduled supplemental air carriers (FAA, 1963a, p. 1). Prior to the 1963 revision, Part 42 required no dispatcher oversight or operational control system for these carriers. Recognizing the safety advantages of dispatch systems, the FAA added regulations to Part 42 requiring "each operator…to establish a dispatch system using certificated dispatchers, or an approved flight following system" (FAA, 1963b, p. 7125). §42.38 listed the requirements for the flight following the system.

> An operator shall show that it has an approved flight following system…adequate for the proper monitoring of the progress of each flight taking into consideration the operations to be conducted…to ensure *[sic]* the proper monitoring of the progress of each flight…and to insure *[sic]* that the pilot in command is provided with all information necessary for the safety of the flight. (FAA, 1963b, p. 7134)

§ 42.381 further defined operational control for non-scheduled supplemental air carriers. "No flight shall be started under a flight following system without specific authority from the person authorized by the operator to exercise operational control over the flight" (FAA, 1963b, p. 7153). Under §42.350, the director of operations and the pilot in command shared operational control of supplemental air carrier flights. With the advent of flight following systems, the air carrier's director of operations could delegate the operational control functions to flight followers or dispatchers, but the director of operations retained responsibility for those functions (Federal Register, 1963b, pp. 7150-7151). Current 14 CFR Part 121 regulations still contain these rules for flight following and operational control for non-scheduled supplemental air carriers.

Lessons of the 1960s and 1970s

Though the expansion of operational control to all air carriers enhanced safety, the 1960s and 1970s brought important lessons related to performance planning, weight limitations, and thunderstorm avoidance. Dispatchers influenced all these areas during flight planning and operations. The result of these lessons meant an improved understanding of planning for airplanes that could now fly higher and faster.

14 CFR Part 121 regulations §121.189 and §121.195 require turbine engine powered airplanes to operate below weights designed to ensure safe operations in the event of an engine failure on takeoff or on approach to landing. Because dispatchers prepare dispatch releases for each flight, they have a direct role in ensuring flights remain in compliance with maximum weight limitations as defined in §121.189 and §121.195. The widespread introduction of heavier jet transports, such as the Boeing 707 and the DC-8, in the early 1960s led to several runway overrun accidents.

Serling (1969) described the problem:

> The FAA's original certification process theoretically required a jet to be able to stop at a certain distance on dry pavements, the distances depending on aircraft landing weight.

> The FAA itself admitted in 1965 that its requirements were on the unrealistic side… (p. 151)

In 1966, the FAA increased landing distance requirements for wet or icy runways by 15 percent (Serling, 1969, p. 151). Dispatchers began considering the runway condition expected at the time of arrival and planning flights below the maximum weight allowed, accounting for the newly required extra 15 percent of landing distance.

The 15 percent increase came into effect too late to save Continental Air Lines flight 12, a Boeing 707 that overran runway 18 at Kansas City Downtown Airport on landing on July 1, 1965. The aircraft landed in heavy rain 1,050 feet past the runway's approach end. The crew attempted to stop the aircraft but was unable to do so due to hydroplaning. The aircraft slid off the runway end and destroyed the ILS localizer antenna building, ultimately stopping on the airport perimeter road next to a levee. All sixty-six on board survived without major injury (CAB, 1966, p. 1).

Ironically, this accident occurred only six days after the July 7, 1965 publication of the Federal Register containing the FAA's (1965) revised regulation, including the extra 15 percent distance margin for turbojet airplanes dispatched to wet or slippery runways (p. 8572). In its explanation for the rule changes, the FAA cited ten incidents between 1960 and 1964 involving turbojet aircraft overrunning landing runways. Nine of these ten incidents occurred on wet or slippery runways (FAA, 1965, p. 8570). The FAA concluded that there had not been more overrun accidents because "most of the airports into which the large turbine engine powered airplanes have been operating have runways that are substantially longer…than the minimums required for landing" (FAA, 1965, p. 8570). The Agency worried that the number of turbojet aircraft operations into shorter runways would result in a significantly higher number of overrun accidents. The new rule became effective on January 15, 1966 (FAA, 1965, p. 8570–8572).

Pan American World Airways Flight 845

The Boeing 747, introduced in 1970 (Zhang, 2016), weighed significantly more than the Boeing 707 (maximum takeoff weight 333,680 pounds) or Douglas DC-8 (maximum takeoff weight 325,000 pounds), with a maximum takeoff weight of 713,000 pounds (Plane & Pilot, 2009). Only 19 months after the Boeing 747's introduction to passenger service, those onboard N747PA underwent a harrowing ordeal caused by dispatcher errors during preflight performance and maximum weight calculations (National Transportation Safety Board [NTSB], 1972, p. 1).

N747PA was a historic aircraft for Pan Am. It was the same aircraft Pan Am used for the first commercial service (Glionna, 2010). On July 30, 1971, dispatchers John Pepin, Francis Keithey, and Edward Anderson (NTSB, 1972, p. 36), stationed at San Francisco International Airport, prepared the dispatch release for the San Francisco – Tokyo flight (NTSB, 1972, p. 6). The dispatcher planned the takeoff on runway 28L, which measured 10,600 feet. He selected runway 01R as a planned alternate runway. He failed to check airport conditions; had he checked, he would have discovered runway 28L closed earlier in the day (NTSB, 1972, p. 7).

The crew radioed the dispatch office to request a departure runway change to runway 01R (NTSB, 1972, p. 7). The dispatcher needed to recompute the maximum available takeoff weight based on the new runway with a different length and obstacles at the runway end. Further reducing the available takeoff distance on runway 01R was a one-thousand-foot blast overrun area at the beginning of the runway (NTSB, 1972, pp. 7-8). Unfortunately, he did not realize the 9,500-foot runway distance listed in Pan American's Route Manual was incorrect. The distance available was only 8,500 feet because the first 1,000 feet were unusable due to the blast overrun. The dispatcher checked performance weight calculations against the clearway computations in Pan American's Route Manual and determined there were no takeoff limitations at the 708,002 pounds planned takeoff weight (NTSB, 1972, pp. 3-4). 14 CFR §1.1 defines a clearway as an area beyond the departure end of a runway that is free of obstacles protruding into an upward-sloping area of 1.25 percent.

Prior to communication with the dispatcher, the crew set takeoff speed "bugs" for the V_1 takeoff decision speed, V_r rotation speed, and V_2 takeoff safety speed. These speeds were set with the assumption of a flap setting of 10 degrees, correct for departure from runway 28L (NTSB, 1972, p. 3). During the runway change dispatch communication, the dispatcher informed the crew that the takeoff required a 20-degree flap setting (NTSB, 1972, p. 4). The crew reset the flaps to the appropriate 20-degree setting, but they did not recheck speed computations for the new flap setting. The speed "bugs" remained set for the initial 10-degree flap setting (NTSB, 1972, pp. 4-5).

The takeoff seemed normal until the first officer noticed the end of the runway "coming up at a very rapid speed" (NTSB, 1972, p. 5). He called for rotation to the takeoff attitude not at the appropriate V_r speed, but because the flight was rapidly reaching the runway end. The crew felt a sudden bump (NTSB, 1972, p. 5), and horrified passengers saw three metal pieces from the runway's approach lighting system shoot through the floor at the rear cabin. The pieces severely injured two passengers. One piece impaled four unoccupied seats. The third piece flew through rear seats and the rear lavatories (NTSB, 1972, p. 14).

The damaged fuselage led to hydraulic systems one, three, and four failing due to fluid leaks. The captain maneuvered the aircraft to check the remaining flight control systems and dumped fuel in preparation for an emergency landing (NTSB, 1972, p. 5). Dumping 180,000 pounds of fuel took about 45 minutes, after which the crew returned to San Francisco. The damaged hydraulic systems meant the aircraft lacked full elevator control authority, and the aircraft touched down hard and bounced. It finally veered off the right side of the runway and stopped at the runway intersection (NTSB, 1972, p. 6).

Chaos ensued during the subsequent evacuation. The flight deck crew did not make a public-address announcement directing the cabin crew to evacuate the aircraft. The evacuation commenced after the crew came down the stairs from the upper deck and shouted to the cabin crew to begin the evacuation (NTSB, 1972, p. 14). Several exit slides in the forward cabin failed, and passengers rushed to usable exits in the rear of the aircraft. The movement of the passengers to the rear, combined with partial landing gear failures, caused the airplane to seesaw back and forth, eventually settling on its tail with the nose gear completely off the ground (NTSB, 1972, p. 24). As the tail settled, the first exit slid in the forward cabin, pointed straight to the ground in a nearly vertical position. Eight passengers were seriously injured as they plunged down on these now-ineffective escape slides (NTSB, 1972, p. 15).

In its final analysis of the accident, the National Transportation Safety Board (1972) calculated that given the existing takeoff conditions, the maximum takeoff gross weight for the available 8,400 feet of runway with clearway should have been limited to 697,400 pounds (p. 18). The aircraft's loaded weight that day of 708,000 pounds required a runway length for takeoff of 8,675 feet plus clearway (NTSB, 1972, p. 18). The NTSB cited these causal factors directly relating to dispatching:

1. The dispatcher prepared a flight release for the longest runway in the airport without ascertaining the status of the runway (NTSB, 1972, p. 17).
2. The dispatcher was "lulled into a sense of complacency" (NTSB, 1972, p. 17).
3. There were no formal procedures for briefing the dispatcher on abnormalities of the operation in effect or expected to happen (NTSB, 1972, p. 17).
4. The Pan American Route Manual contained errors (NTSB, 1972, p. 21).
5. The dispatcher failed to propose the use of runway 28R to the flight crew even though the wind favored it. He simply reverted to his original alternate runway plan of 01R (NTSB, 1972, p. 20).

The probable cause determined by the NTSB (1972) was:

> …the pilot's use of incorrect takeoff reference speeds. This resulted from a series of irregularities involving (1) the collection and dissemination of airport information, (2) aircraft dispatching, and (3) crew management and discipline, which collectively rendered the air carrier's operational control system ineffective. (p. 1).

Aside from the previously described conclusions reached by the NTSB, additional lessons can be learned from this accident. Individuals involved in this accident repeatedly trusted each other, but through misunderstanding, miscommunication, or bad information, safety buffers broke down. We cannot know the exact cockpit sequence of pre-departure events, but the captain may have assumed the first officer or another crewmember had reset the speed "bugs" prior to departure. Airport personnel assumed that the FAA disseminated San Francisco International Airport flight safety information properly to dispatchers and flight crew. Dispatcher Kelthey assumed Pan Am's route manuals contained correct runway distance information. While not every piece of information can be verified prior to its use, crewmembers, dispatchers, and airline managers tasked with highly technical and safety-sensitive functions must confirm the use of correct procedures and information.

Additionally, Pan Am 845's evacuation encountered major issues. No one was killed, but many passengers sustained preventable evacuation injuries because of a lack of crew communication and poor manufacturer information about fuel dumping processes when combined with damaged hydraulic and landing gear systems. Pan Am 845 resulted in an evacuation where nothing went as planned. As a result, airlines now repeatedly practice emergency egress drills and stress crew coordination such that modern emergency evacuations typically result in few to no passenger injuries, provided there is no post-accident fire.

Pan Am 845's accident report notably listed the three Pan Am dispatchers' names and dispatcher certificate information. No previous aircraft accident reports included dispatcher names along with the flight crewmember names. Ultimately, dispatchers and pilots share a tremendous amount of responsibility for operational control and safe operations. This accident clearly illustrates the potentially fatal consequences that can occur when operational control breaks down even in the preflight planning process.

Thunderstorm Avoidance

Since the advent of commercial aviation, thunderstorms caused delays, diversions, and accidents. Airlines attempted to find ways to avoid enroute weather while maintaining scheduled operations. In 1949, American Airlines and the United States Navy conducted tests of an onboard weather radar system installed in a Convair airliner ("Flying Lab," 1949, p. 28). In 1956, American Airlines equipped its fleet of DC-7s with airborne weather radar ("AA to Equip," 1955, p. 20). Airlines quickly embraced the innovative technology, and Aviation Week (Christian, 1955) quoted a Northwest Airlines pilot: "We all wonder how we ever got along without it. Pretty soon the public won't fly in anything but radar-equipped airplanes" (Christian, 1955, p. 40).

Radar was life-changing for the crews who formerly navigated through areas of embedded thunderstorms by guesswork and prayers or significant routing changes. This new technology quickly became trusted by flight crews and dispatchers, and Job (1994) states:

> …since the advent of airborne weather radar, more and more aircraft were being dispatched in marginal weather, with the captain having the primary responsibility for avoiding severe conditions…too much reliance was probably being placed on an instrument that could not 'see' the turbulence itself. (pp. 58-59)

Several aircraft accidents in the late 1950s and early 1960s demonstrated this faulty reliance by dispatchers expecting pilots to avoid enroute thunderstorms and weather but failing to provide vital information on enroute weather conditions. These accidents included Capital Airlines flight 75 in 1959 (CAB, 1959), Mohawk Airlines flight 112 in 1963 (CAB, 1964), two different Braniff International Airways flights, flight 250 in 1966 (NTSB, 1968), and flight 352 in 1968 (NTSB, 1969).

One of these accidents that emphasized this misguided reliance on crews for inflight weather avoidance was highlighted by the NTSB (1968) in its report on Braniff International Airways flight 250 (p. 15). On August 6, 1966, a BAC 1-11 designated as flight 250 departed from Kansas City bound for Omaha. Prior to departure from Kansas City, the crew discussed the expected enroute weather with another Braniff flight crew that had just arrived from Chicago. The incoming crew described "a solid line of very intense thunderstorms with continuous lightning and no apparent breaks" (Job, 1994, p. 53).

Dispatchers were aware that another Braniff flight had delayed its takeoff from Sioux City because of weather at Omaha, and yet another Braniff flight between St. Louis and Omaha had diverted to Kansas City after its pilot elected to completely avoid the intense squall line of thunderstorms (NTSB, 1968, p. 14). Dispatchers failed to inform the crew of flight 250 of the other crews' decisions to avoid the weather. The dispatcher testified to the NTSB (1968):

> If he received a severe weather warning for an area through which company aircraft were operating, it was doubtful that he would forward this information to enroute aircraft. In his opinion, the crews in the area would be better able to evaluate the weather than he could. (p. 15)

Flight 250 continued ahead toward the line of thunderstorms, requesting a deviation to the left to avoid weather (Job, 1994, p. 55). It suddenly encountered a severe gust of wind in the turbulent shear zone near the line of thunderstorms. The gust broke the elevator and rudder from the tail, and seconds later, the right wing failed (Job, 1994, p. 56). Witnesses who had been outside watching the approaching storm saw the aircraft plummet to the ground, killing everyone on board (Job, 1994, p. 54).

The NTSB (1968) determined the probable cause to be "inflight structural failure caused by extreme turbulence during operation of the aircraft in an area of avoidable hazardous weather" (p. 59). The word "avoidable" in the Board's probable cause is tied directly to the dispatcher's error of omission. The dispatcher possessed weather knowledge but failed to provide it to the crew of flight 250. As a result, 42 people perished (NTSB, 1968, p. 1).

Conclusions

This research project successfully documents, in detail, the early development of the dispatcher and how dispatchers became inherent to safe and reliable air transportation. Dramatic improvements in airline accident rates are attributable to many causes. Fatality rates per 100 million passenger miles flown declined sharply with better operational control, communications, weather monitoring, and operational oversight. A comparison with 1932 rates – 14.96 deaths per 100 million passenger miles flown (Serling, 1969, p.43) – demonstrates this steep decline. Rates fell steadily from 0.50 fatal accidents per 100 million passenger miles in 1952-1956, fell again to 0.22 in 1962-1966 (Serling, 1969, p. 47), then to 0.121 in 1975, and finally dropped to 0.034 in 1980 (Department of Transportation [DOT], n.d.). Since 2009, the fatality rate has been near zero (DOT, n.d.).

The system of operational control exercised by dispatchers and flight crews contributes significantly to this excellent safety record. Today, dispatchers undergo stringent training and certification. All Part 121 air carriers require operational control systems, both for scheduled and non-scheduled operations. Modern flight position reporting technologies and weather reporting systems provide dispatchers with more real-time information than ever before. Today, the dispatcher is able to utilize a complete and comprehensive view that includes more information than flight crews can access. The *Aviation* article previously quoted in this paper, "Flying with One Foot on the Ground" (1937) described the then-novel concept:

> A properly trained dispatcher, sitting apart from the immediate stress and strain of flying the airplane and with all possible forms of information at his disposal, has an opportunity

> to sit down and figure things out in a way that is not possible for the pilot with his many flying duties. (p. 72)

This research project demonstrated how this early concept of a dispatcher's role became a reality, examining the period from 1929 through the 1970s. As air transportation evolved in the United States, the dispatcher's role also evolved. Dispatchers grew from glorified radio operators to trusted ground crewmembers, enabling flight crews today to fly with one very important foot on the ground.

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