

History of Air Traffic Control

Nolan, Chap 1

Themes

1. Air traffic grows in excess of capacity -> accidents -> government responds -> air traffic grows in excess of capacity -> accidents -> government responds ...
2. Government slow to respond to trends, but responds to accidents
 1. “Tombstone effect”
3. Politics plays a significant role in FAA decision-making
 1. Example, closing outdated facilities very difficult
4. Conflicting objectives (1) promote aviation, (2) build capacity, (3) maintain safety
5. FAA is one-step behind (capacity, procedures, funding)
6. FAA system reliant on highly specialized labor force

Era's

1. 1903 – 1925:
 - Airmail Service
 - Congestion at airports and public mistrust threatens economic growth
2. 1925 – 1934:
 - Morrow Report/Air Commerce Act 1926
3. 1934 – 1945:
 - Civil Aeronautics Act 1938
4. 1945 – 1955:
 - Air Traffic Congestion
5. 1955 – 1965:
 - Implementation of Radar
 - Creation of Federal Aviation Administration
6. 1965 – Present:
 - Department of Transportation
 - Airline De-regulation
 - ATC Modernization

Early Aviation Developments, 1903 – 1925

- Demonstrated usefulness of aviation
 - Airmail
 - Started 1911
 - USPS routine airmail service 1918
 - Military
 - WW I - Observation platform, weapons delivery
 - Agriculture
 - U.S. Department of Agriculture
 - pesticide

Airmail Service

- Airmail service by U.S. Post Office
 - 1925 transcontinental service
 - Day-time operations only
 - Experimental night flights
 - Bonfires - 1921
 - Electric, Gas beacons
 - 1923 Dayton to Columbus, OH
 - 1924 Cheyenne, Wyoming to Chicago, Illinois
 - **Airmail Act 1925**
 - Authorized Postmaster General to contract airmail delivery to private companies
 - Boeing, Douglas, Ford provide airplanes and service

Morrow Report, 1925

- Increase in air traffic requires “navigational regulation” of industry
 - Unify industry through set of rules, procedures, and certification
 - Regulation needed to grow industry (and gain public trust)
- President Calvin Coolidge commissions Dwight Morrow to recommend future government policy
- Military and Civilian aviation operate separately
- Department of Commerce given responsibility to:
 - Promote civilian aviation
 - Regulate civilian aviation

Air Commerce Act, 1926

- Purpose of act
 - “not so much to regulate as to promote civilian aviation”
 - Aeronautic Branch of Department of Commerce
 - Establish airways and navigational aids
 - Regulate as necessary to elevate public’s perception of aviation as safe
 - License pilots
 - License mechanics
 - Regulate use of airways

Methods of Traffic Avoidance, 1920s

- Visual Flight Rules (VFR)
 - Principle method of air traffic avoidance - “See and be seen”
 - Visual Flight Rules (VFR)
 - Pilots fly clear of clouds
 - Visibility of at least 3nm
- Instrument Flight Rules (IFR)
 - Increased demand for night and marginal visibility
 - Increases in aircraft performance
 - Improvements in Instrumentation
 - Gyroscope for wings-level to horizon when horizon not visible
 - Pilots takeoff, cruise and land in weather conditions that do not permit VFR
 - Instrument Meteorological Conditions (IMC)
 - Ground-based navigation aids (naviads) needed at airports and en-route

Regulating Takeoff and Landing, 1920's

- Airports congestion points need Air Traffic Control
 - Colored flags (red stop, green go)
 - St Louis – 1929
 - Light Guns
 - Aim narrow beam of high-intensity light (red stop, green go)
 - Radio Communication
 - Two-way communication
 - Radios expensive, unreliable, and cumbersome
 - Lack of standards and procedures

Airport Congestion Threatens Commerce 1930's

- Airports crowded
 - Threat of mid-air collisions
 - Threat of crashes into neighborhoods
 - DC-2, DC-2, Boeing 247
- Residents pressure cities and states to enact legislation to restrict air travel
- Federal government feared restrictions would retard growth

Bureau of Air Commerce, 1934

- Congress created Bureau of Air Commerce
 - Part of Department of Transportation
 - Responsible for regulation of traffic along nations airways
 - Federal Government responsible for:
 1. Licensing pilots
 2. Establishing airways and navigation aids
 3. Separation and safety of aircraft using the airways
 4. Instrument Flight Rules (IFR)
 - Rules for flying airways under Instrument Meteorological Conditions (IMC)

Air Traffic Control Units (ATCUs), 1935

- Department of Commerce (DoC) unable to form an ATC system
 - Depression era – budgets limited
- DoC requests airlines ATCUs
 - TWA, American, Eastern, United Airlines
- DoC promises to takeover operation of ATCUs at later data
- ATCU's:
 - VFR – do nothing
 - IFR – separate traffic

ATCU's, 1936

- Pilots file flightplan when plan to fly airways in IMC (becomes law in 1936)
 - Type of aircraft
 - Departure and Arrival airports
 - Estimated Departure Time
 - Estimated Time Enroute
 - Airline Flight Number
 - Requested Route of Flight
 - Aircraft Cruise Speed
 - Requested Cruising Altitude

ATCUs, 1936

- Responsibility
 - determine if route and altitude conflicted
 - issue Air Traffic Control clearance
 - Move *shrimp boats* on map based on pilot updates
- Air Traffic Controllers at ATCU (3)
 - A controller – separation and communication
 - B controller – disseminate updated weather reports
 - C controller – calculates estimated position of aircraft
- Active Control vs. Passive Control

ATCUs transition to ATCSs, 1937

- Problems with ATCU's operated by airline employees
 - May have favored own company flights
 - Pilots not required to file flightplans for IMC until 1936
 - No standard procedures for separation
 - No agreement to transfer control ATCU to airport
- DoC acquires ATCUs from airlines 1937
 - Renamed Air Traffic Control Stations (ATCSs)
 - Airline employees become Federal employees
 - Licenses ATC (for ATCSs and Towers)

Civil Aeronautics Act, 1938

- Created Civil Aeronautics Authority (CAA)
 - Civil Aeronautics Board (CAB)
 - Issues routes to airlines and sets fares
 - Air Safety Board
 - Investigates accidents and make safety recommendations
 - CAA Administrator
 - Operate components of ATC
 - Foster aviation
 - Certify air traffic controllers

Reorganization of CAA, 1940

- Civil Aeronautics Board
 - Issues routes to airlines and sets fares
 - Investigates accidents and make safety recommendations
 - Part of DoC
- Civil Aeronautics Administration
 - Created Civil Air Regulations (CARs)
 - Legal authority to controllers
 - Pilots certified
 - IFR pilots federally mandated equipment
 - Federal controllers at Towers and ATCCs (23)
 - Federal Airspace between major cities = Controlled Airspace

World War II (1940-1945)

- Triggers explosive growth in aviation
 - Technologies
 - Demand/Economics
 - Trust
- Military creates separate ATC
- Interstate Airway Communication Stations (INSACs)
 - Flight advisory services across country
 - Provide weather and ATC instructions from ATCCs
 - Precursor to Flight Service Stations (FSSs)
- International Civil Aviation Organization (ICAO)
 - International standards
 - Adopted US standards

RTCA Special Committee 31 Report, 1941

- RTCA SC-31 recommendations:
 1. Common (military, civilian) ATC
 2. Requirements for navigational systems
 - VHF Omnidirectional Range (VOR) and Distance Measuring Equipment (DME)
 3. Airport Surveillance Radar (ASR) at busy airports
 4. Transponders on aircraft to broadcast altitude and identification
 5. Instrument Landing System (ILS) and Precision Approach Radar (PAR)

Air Traffic Congestion, Again (1950+)

- End of 1940's
 - ATC procedures no longer handle volume of traffic
 - Inaccuracies in “Shrimp boat tracking” requires separation of 10 minutes (= 50 to 100 miles)
 - Air Traffic Controllers had to
 - Hold aircraft in flight
 - Delay departures
- “Black Wednesday” 1954
 - 45,000 passengers delayed

Implementation of Radar, 1956

- CAA introduce **Air Route Surveillance Radar** (1956)
- Secondary radar (using Transponder data) installed 1957
 - **Air Traffic Control Radar Beacon System (ATCRBS)**
- Funding cutbacks slow installation

Grand Canyon Accident, 1956

- Aircraft operating VFR in uncontrolled airspace collide over Grand Canyon
- Findings:
 - Pilots go VFR to take short-cut, get out of congested routes
 - CAA denied responsibility for accident (VFR, uncontrolled airspace)
 - CAA insufficient airspace or controllers to handle traffic demand
 - Few new airways developed
- Results:
 - Congress appropriates funding, 1956
 - 23 ARSRs (Air Route Surveillance Radars)
 - 18,000 and above possible for controlled airspace
 - 40 new control towers
 - 1,400 new controllers

Federal Aviation Agency, 1958

- Accidents involving military and commercial aircraft above 18,000 ft
- CAA cannot hire and staff ATC
- ATCo'f form union NATCA
- FAA formed
 - Cabinet level officer appointed by President

Project Beacon, 1961

- Recommendations:
 - FAA projects be better coordinated
 - FAA research no longer guided by RTCA SC-31 report over 20 years old
 - FAA research balanced between long-term and near-term
 - Install sufficient radar surveillance equipment to permit ATCos to maintain separation from takeoff to landing
 - Use of secondary radar (transponders)
 - Computers be used to relieve controllers of clerical duties (e.g. writing strips)
 - Flight Data Processing (FDP) system
 - Radar display with aircraft identification
- Results:
 - Tower and Approach Control – Automated Radar Terminal System (ARTS)
 - Air Route Traffic Control Centers (ARTCCs) – Radar Data Processing (RDP)

Controller Unionization, 1961

- President Kennedy, Executive Order 10988, 1961
 - Legal for Trade Unions to represent Air Traffic Controllers
- FAA problem
 - Operation of system critical to well-being of country
 - Work-force permitted to unionize
- Professional Air Traffic Controllers Organization (PATCO)
 - Limited to membership of controllers
 - Militant and vociferous

Department of Transportation, 1967

- Consolidate national interests in transportation under one agency
 - Department of Transportation
- Federal Aviation Administration
 - Administrator reports to Secretary of Transportation
 - FAA budget rolled into DOT budget
- National Transportation Safety Board
 - Investigates all transportation accidents

Labor Unrest, 1968, 1975

- FAA budget cuts slowing installation of new equipment
- Airports becoming more congested, delays increasing, mid-air collisions affecting public perceptions
- ATCo's becoming more agitated
- ATCos hired in 1940's start retiring
- PATCO – “Operation Air Safety” 1968
 - Members ordered to adhere to FAA safety standards
 - Perceived as “slowdown”
- PATCO sickout, 1975
- FAA recognize system at capacity
 - Authorize funding and increase rate of modernization

Airline Deregulation, 1978

- Airlines routes structure and fares determined by CAB
 - No competition
- CAB abolished
- Airlines determine routes (networks) and fares
 - Fares reduced to all-time lows
- Airlines migrated to “hub-and-spoke”
- Pressure on ATC

Controllers Strike, 1981

- PATCO desired ATCos separate from Civil Service System (CSS)
 - Otherwise all gains required to be made to all government employees
 - USPS has own employment agreement
- PATCO illegal strike, August 3, 1981
- President Reagan fires 10,000 controllers
- Time to train new ATCos (took 10 years)
 - Temporary flight restrictions
 - Flow control – restricts departure until sufficient airspace
 - Substitutes ground delays for airborne holding

Future NAS Performance

- Demand continues to grow
- Capacity limited by:
 - Hub-and-spoke network
 - Aircraft gauge (seats/aircraft)
 - Separation distance on departure and approach
 - Wake Vortex separation distance
- Safety margins reduced by “pressure” of demand

Future Functions

Function	Current	Future
Communications	<ul style="list-style-type: none"> •Domestic VHF/UHF •Oceanic HF •Limited data-link (mode-C, ACARS) 	<ul style="list-style-type: none"> •Satellite voice •Satellite or Mode-S data-link
Navigation	Ground-based Transmitters (VOR, ILS, NDB)	Satellite-based (e.g. GPS)
Surveillance	Radar Position Reporting	Automatic Dependent Surveillance (satellite)
Air Traffic Management	Controller interprets data, then makes decisions	Computer makes short-term aircraft separation decisions Controller manages airspace

Future

Future Staffing Problems

- FAA controllers
 - hired under 30
 - Eligible for retirement after 20 to 30 years
- All current FAA ATCo workforce hired between 1981 and 1990
- Majority of controllers able to retire between 2002 and 2012

Summary

- Airmail Act – 1925
 - Authorized Postmaster General to contract airmail delivery to private companies
- Morrow Report – 1925
 - Unify rules
- Air Commerce Act – 1926
 - Aeronautic Branch of Department of Commerce
- Bureau of Air Commerce – 1934
 - Part of DOC
- ATCUs - 1935
- ATCUs transition to ATCSs, 1937
- Civil Aeronautics Act – 1938
 - CAB
 - Air Safety
 - CAA
- Reorganization of CAA – 1940
 - CAB
 - CAA
- RTCA Special Committee 31 Report – 1941
 - Vision for future
- Grand Canyon Accident – 1956
- Federal Aviation Agency – 1958
 - Agency in Presidents cabinet
- Project Beacon – 1961
 - Controlled airspace
- Controller Unionization – 1961
- Department of Transportation, 1967
 - Federal Aviation Administration
 - National Transportation Safety Board
- Airline Deregulation – 1978
- Controllers Strike - 1981

Homework #1

1. What are VFR and IFR ?
2. Why did the Federal Government become involved in air traffic control ? Should the government remain involved? Explain.
3. What is controlled and uncontrolled airspace?
4. What are the roles of the Federal Aviation Administration? Explain why there are conflicting objectives between roles?
5. Describe one of the major themes in the evolution of the National Airspace System in the U.S. Provide example(s)?