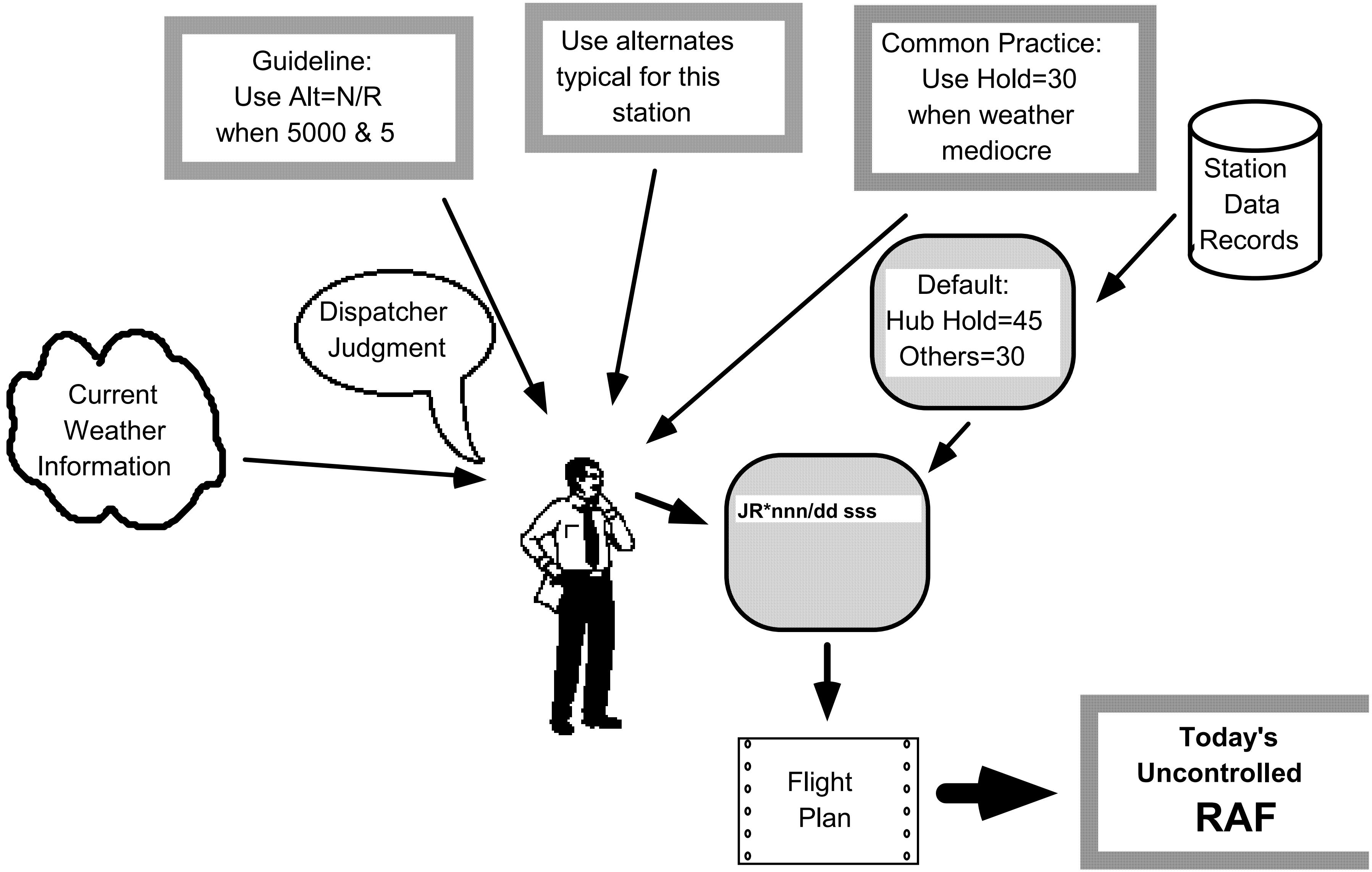
Destination-Specific RAF Overview

- <u>Ultimate Goal:</u> Reduce the amount of fuel needlessly carried, thereby saving money and increasing payload capability
- <u>Long-Term Objective:</u> Accurately define the amount of fuel necessary for a given flight, ultimately with a computer system that can treat each flight independently, and monitor progress
- <u>Near-Term Objective:</u> Implement as a first step an analytical, destination-specific RAF for all domestic destinations, using manual methods.
- <u>Highlights:</u> A methodology has been developed to tie hold fuel to an analysis of delay history, weather conditions, and emergency requirements. The initial implementation of the preliminary approach will lead to a natural progression to the long-term objective.

Flight Plan Generation
Current Approach to Hold Time & Alternates



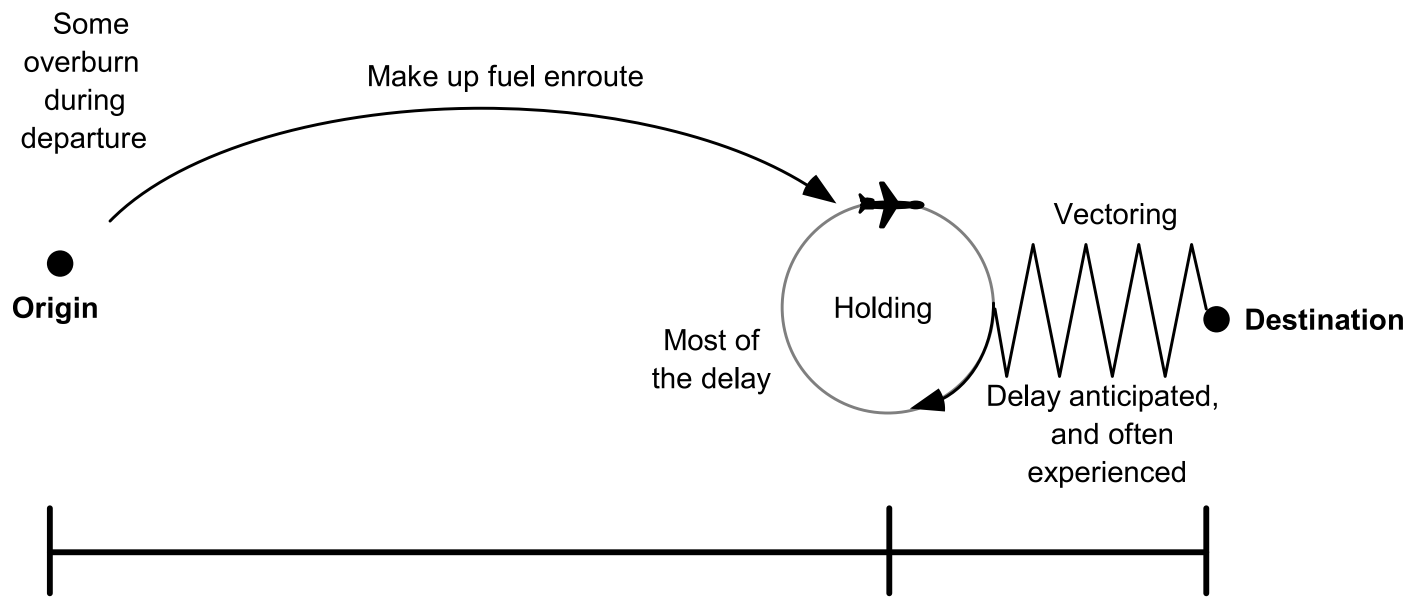
Ramp Arrival Fuel Guidelines
How Goes It? (November 1991)

• **B727 domestic:**	**14,000 lb = 78 min. over reserve (including alternate)**
• **MD80:**	**11,000 lb = 80 min. over reserve (including alternate)**
• **DC10 domestic:**	**27,000 lb = 85 min. over reserve (including alternate)**
• **B757 domestic:**	**15,000 lb = 79 min. over reserve (including alternate)**
• **B767 domestic:**	**16,200 lb = 75 min. over reserve (including alternate)**

What Do Other Airlines Do?
(from Airline Dispatchers Federation Conf. in MSP)

- Delta:
  - Good weather: ALT=N/R, HOLD=45
  - Bad weather: Maximum
  - DFW good weather: ALT=N/R, HOLD=60
- Southwest:
  - Good weather: ALT=N/R, HOLD=20
  - Bad weather: Maximum
- Northwest:
  - Good weather: ALT=N/R, HOLD=30
  - Bad weather: Maximum
  - DTW good weather: ALT=N/R, HOLD=15-20

Destination-Specific RAF Proposal
Why Is a Conservative Approach Necessary?



- **Many factors cause overburn, irrespective of delays, holding, or the counterbalance of direct routings:**
  - **SIDs and STARs assume short mileages, don't adjust for many situations**
  - **Not reaching altitude due to ATC**
  - **Anti-ice**
  - **Speed-up or slowdown at arrival**
  - **Etc.**

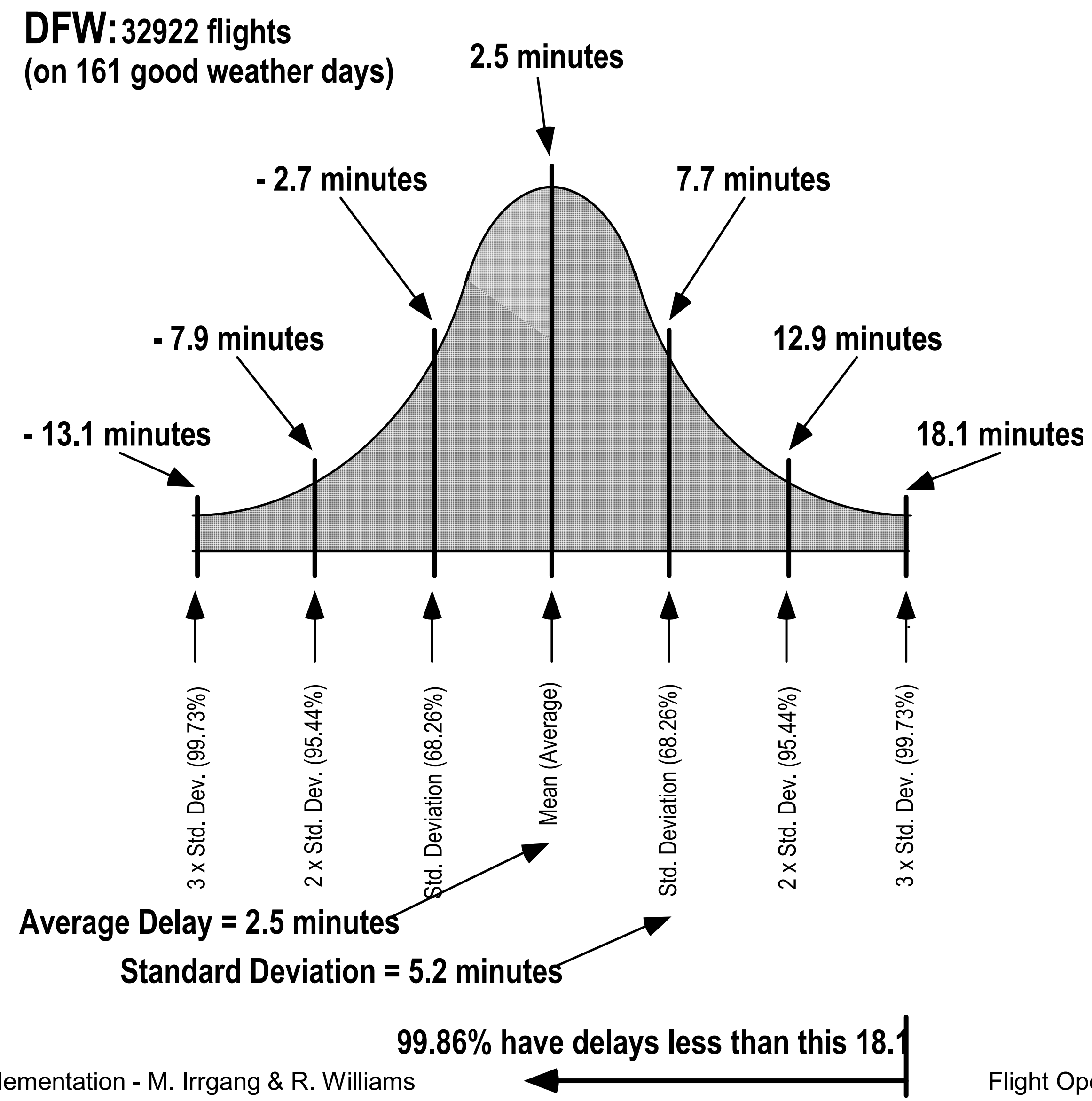
Destination-Specific RAF
What Is The Methodology?

- **Formalize plans by weather: Good weather (Alternate = N/R, ceiling/vis. 2000' & 3), Bad weather (diversions possible), Alternate weather (all other)**
  - **Good Weather:**
    - Base on ALT=N/R + 99.9975% delay figure for hold
    - Use close alternates where possible, but with equivalent fuel
    - For some destinations, based on potential emergency considerations, always use alternates with 99.87% delay figure for hold
  - **Alternate Weather**
    - Use typical alternates with 99.87% delay figure for hold
  - **Bad Weather**
    - No change from current practice of maximum fuel

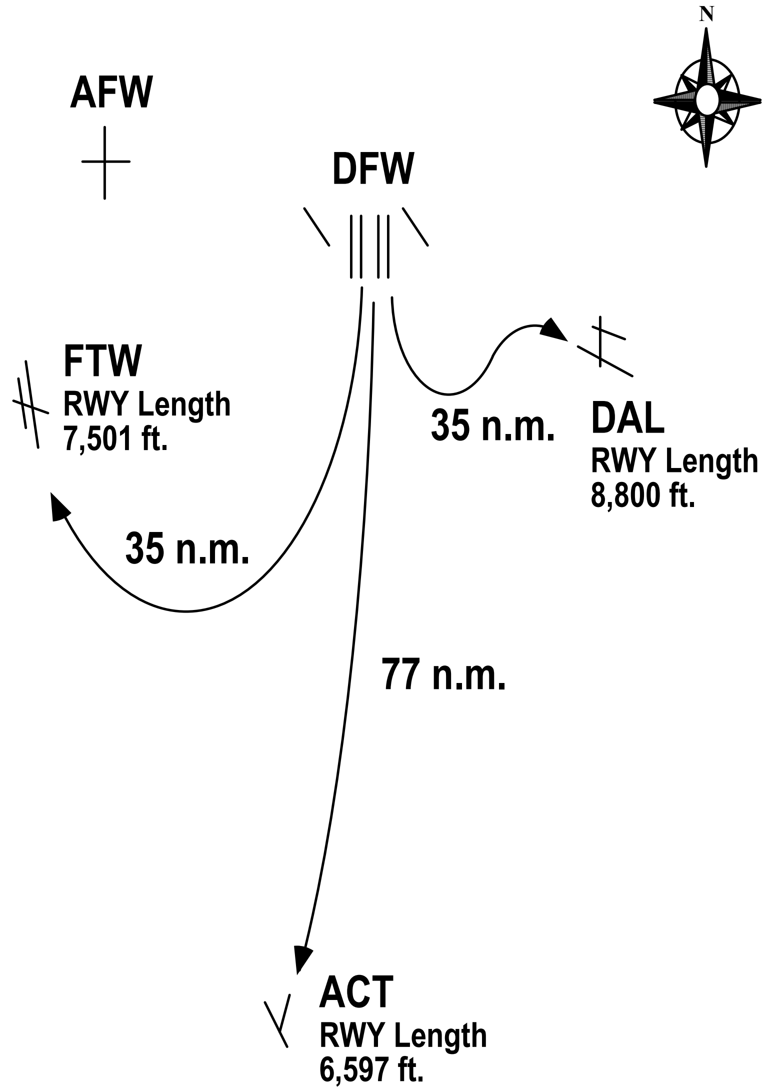
The DFW Experiment

- Objective: create destination-specific RAF prototype
- Account for unique airport characteristics
    - Airport configuration
    - Traffic
    - Weather
    - Proximity to alternates

The DFW Experiment
Good Weather Delay Analysis



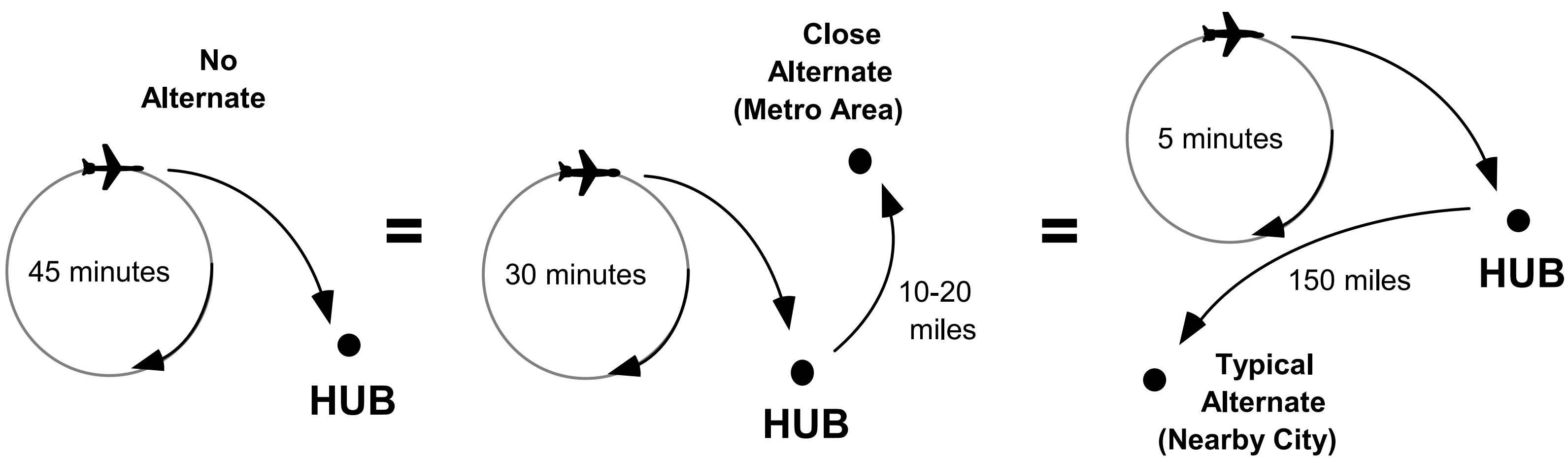
The DFW Experiment
Alternate Airport Selection



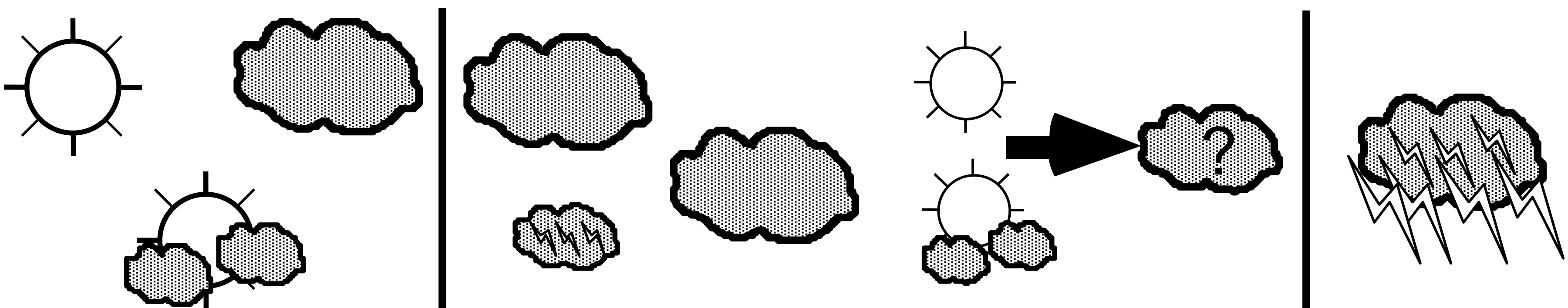
The DFW Experiment
Current Guidelines vs. DFW Prototype Results

- **Current guideline**
  - **No alternate, 45 min. hold, 45 min. rsv.**
  - **Actual guideline compliance: Equivalent to no alternate, 50 min. hold, 45 min. rsv.**
- **DFW prototype**
  - **DAL or FTW, 20 min. hold, 45 min. rsv.**
  - **Equivalent to no alternate, 38 min. hold, 45 min. rsv.**
- **400 flights dispatched Jan-Apr 1991**
  - **Achieved guideline across all aircraft types**
  - **Bottom line vs. typical release: Saved 12 minutes hold fuel**

Alternate vs. Hold Philosophy
Trading Off Different Views of Hold Time



Weather Guidelines Approach
How We Define the Weather Continuum



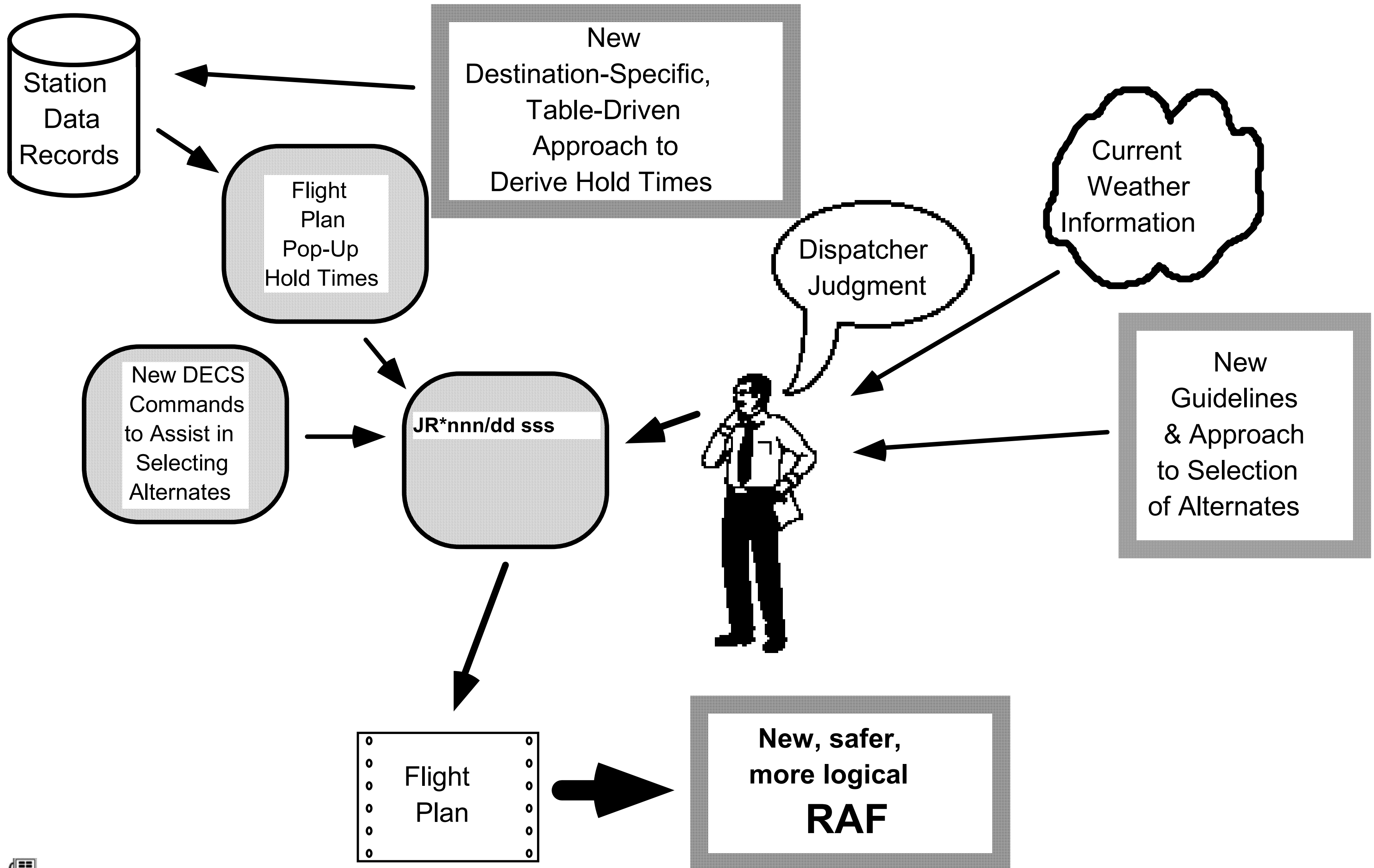
Good Weather	Alternate Weather		Bad Weather
"2000 and 3" ALT=N/R Weather (unchanging)	Any Other Conditions (predictable, unchanging)	Deteriorating Weather (good-but becoming unpredictable)	Likelihood of Diversions

New RAF Standard
Alternate Airport Selection

- Alternate management is the key element in RAF management.
- Obviously, always plan to protect reserve fuel & plan an alternate whenever required by FAR
- Plan a close-in alternate wherever possible, especially at busy airports
- Programming needed to assist dispatch in more standardized approach
  - Ranking of alternates by mileage from destination
- Diversion airport ops advisory for Flight Manual Part II
  - Make crew more comfortable with off-line alternates
  - Need viable plan if airport closes on short notice
- Alternate selection
  - Balance flights between closest suitable alternates
  - Move away from paper alternates
  - Ensure all suitable airports systematically considered

Flight Plan Generation

New RAF Standard Approach to Hold Time & Alternates



Why Is It Important to Manage RAF

- **To maximize revenue payload capability**
  - **Offset increases in avg. psgr and bag weights to extent possible**
  - **Route structure impacts**
    - Long spokes - high load factors
    - Limited aircraft with suitable range
- **Minimize fluctuations in payload capability**
- **Reduces cost**
  - **Fuel cost to carry fuel**
  - **Maintenance expense**
    - Fewer max power events
    - Less time at climb power
    - Brake wear
    - Etc.

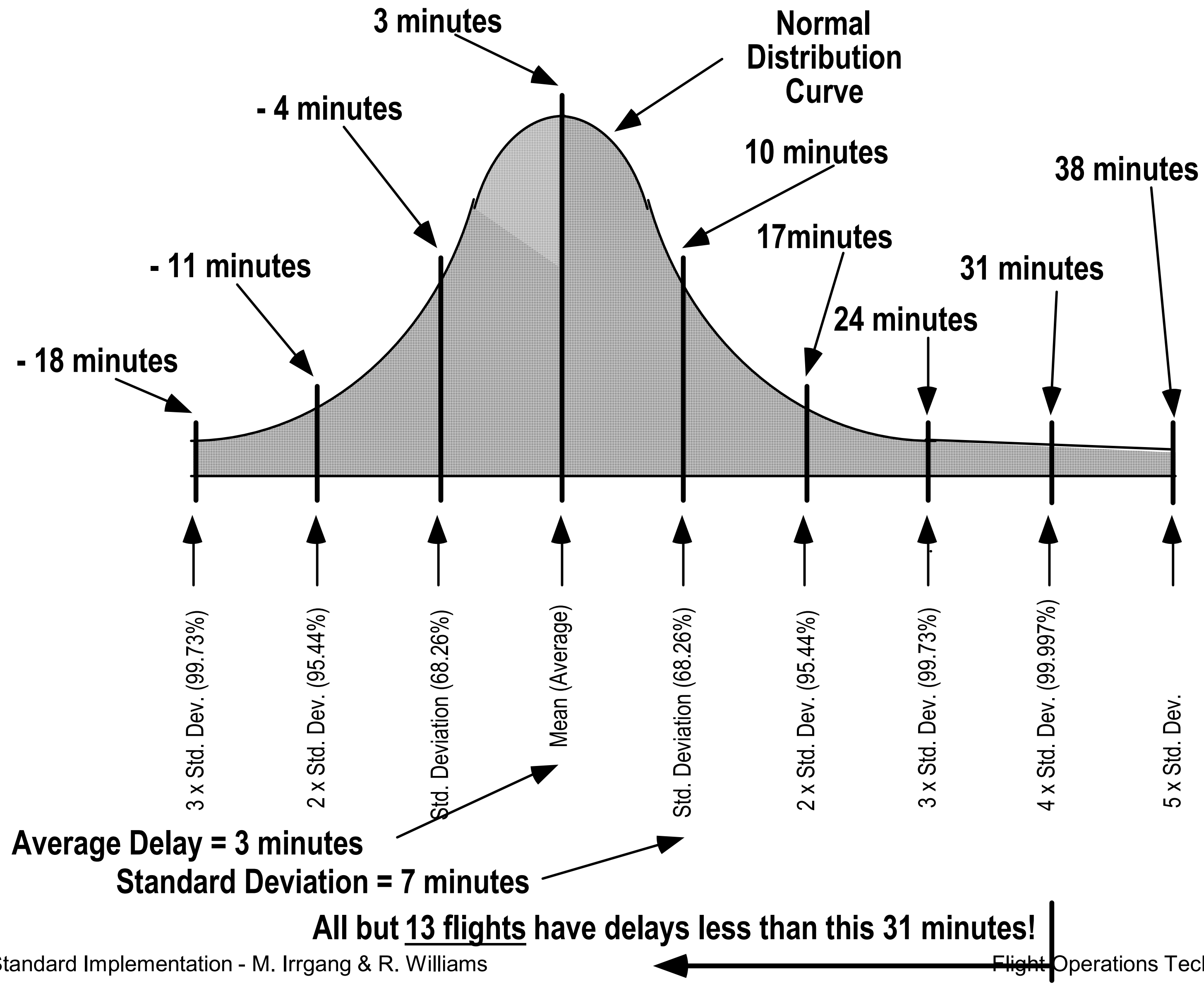
Destination-Specific RAF
Why Will This Work?

- We are offering the first true plan for how to scientifically determine required RAF
- Monitoring of DFW, SJC, SFO, OAK, MCI, AUS, SAT, and BNA shows that current RAF levels are well above current guidelines. Little consistency of hold time and alternate selection offers much opportunity for savings as we implement the RAF standard
- This is only the <u>first step</u> in controlling RAF!

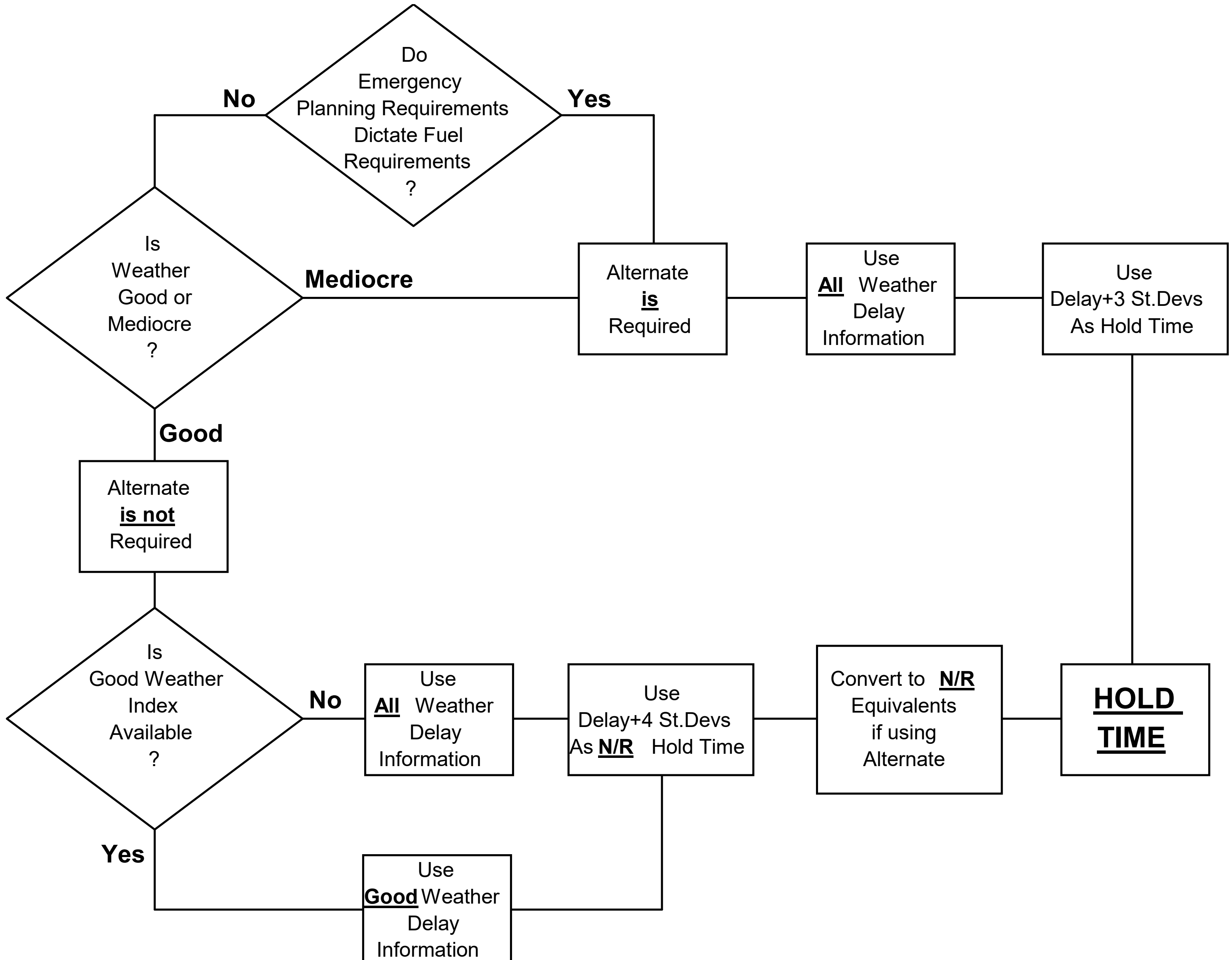
RAF Standard Update
Estimation of Savings

- This program will reasonably and justifiably cut flight plans by an average 22 minutes of fuel, providing an average reduction in RAF of about 3,000 pounds, across all fleets.
- This reduction will conservatively reduce fuel burn by approximately 1.25%, resulting in a conservative savings estimation of approximately $20 million.
- The magnitude of the savings is so high in spite of not cutting RAFs to "uncomfortable" levels
- The magnitude of the savings can be so high because of the impact of cutting hold time in mediocre weather conditions, for the first time.
- Factors which would increase the savings would be:
    - Additional passenger and cargo revenue due to reduced load restrictions.
    - Additional reduced fuel burn from increased ability to fly at optimum altitudes on long flights.
- The main factor which would decrease potential savings would be to not effectively manage the new hold times, both with pilots and dispatchers. We have been able to move so fast recently because SOC had assigned Danny Burgin to manage fuel.

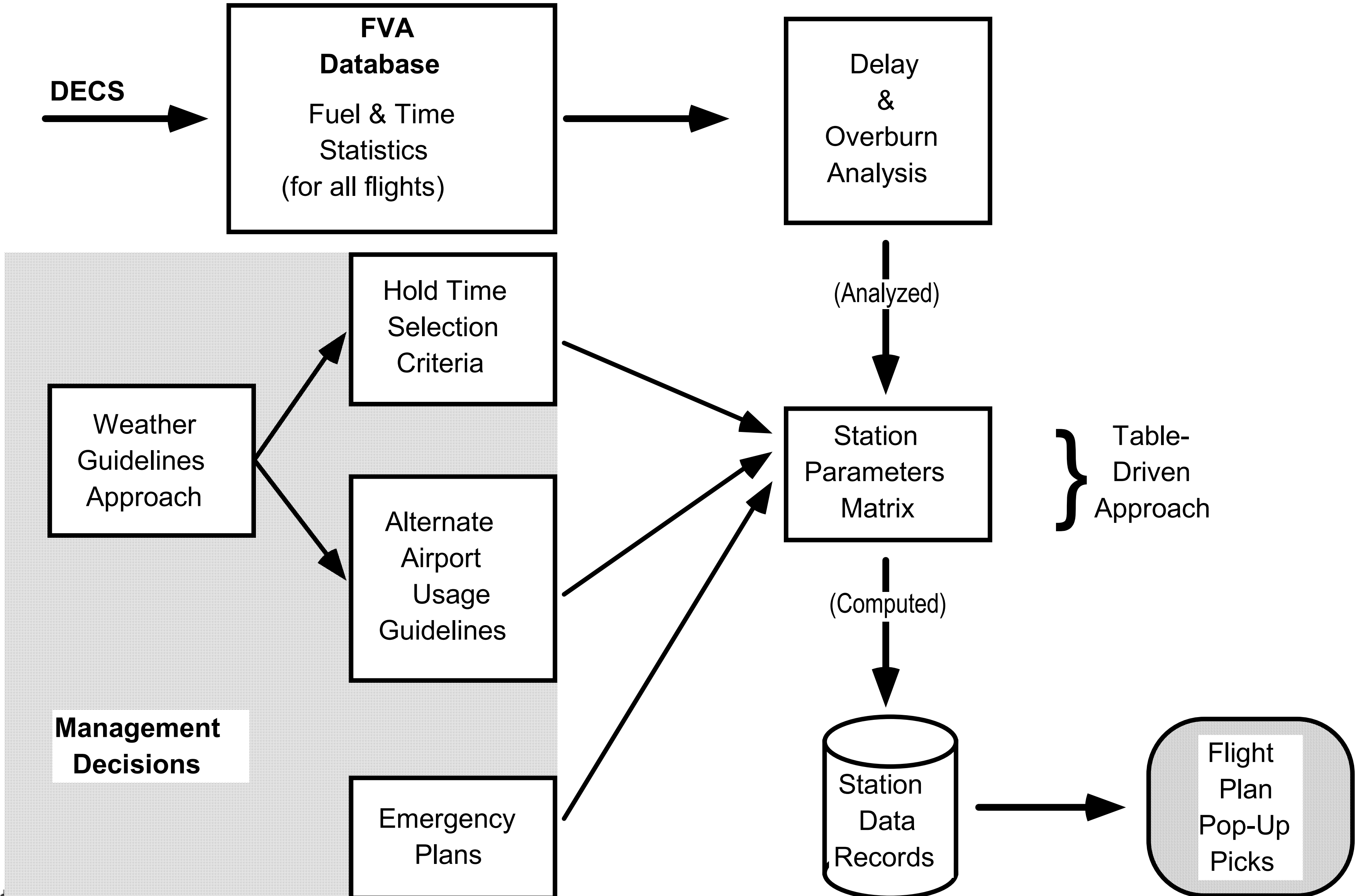
Air Delay Statistics
875,000 Flights per Year, System-Wide, All-Weather



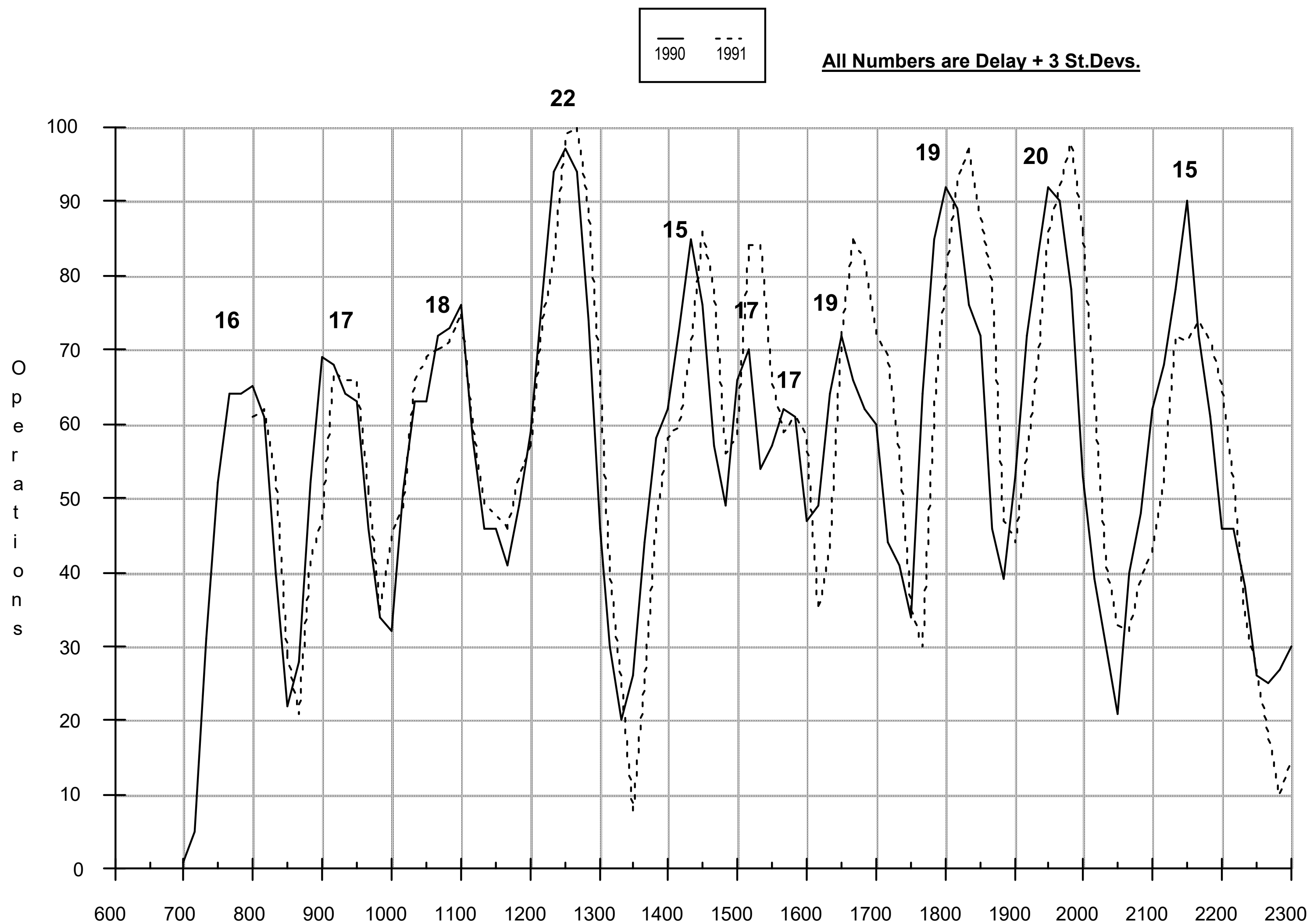
Generation of Delay-Driven Hold Times
What is the Basic Algorithm?



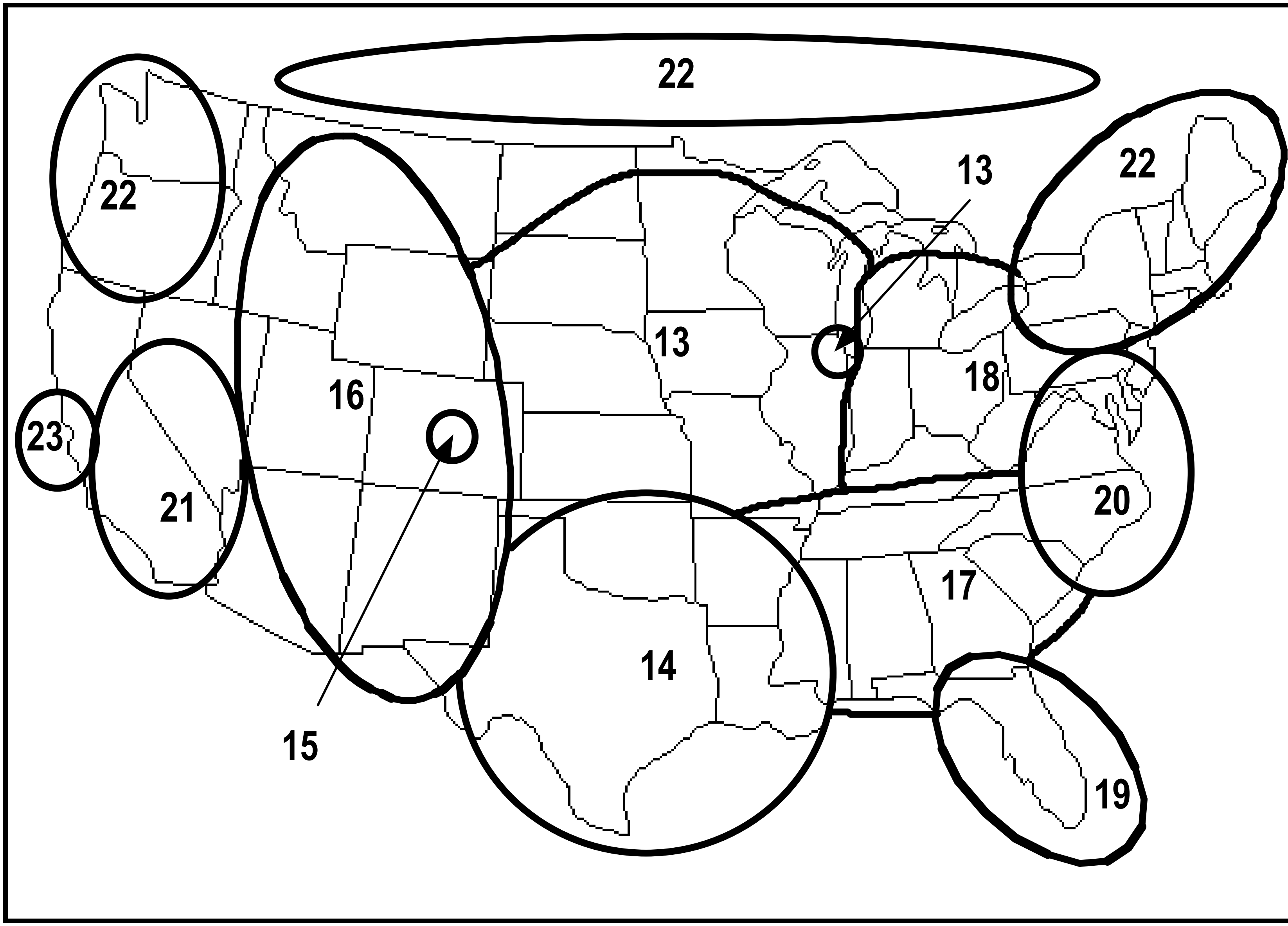
Flight Planning
Table Driven Approach



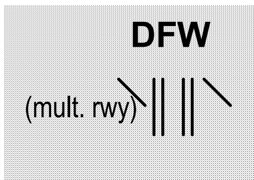
The DFW Experiment
Good Weather Peaking Analysis



The DFW Experiment
Good Weather Origin Analysis



When Does an Airport Not Require Emergency Fuel?
Different Safe Landing Alternatives

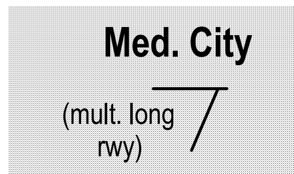


Emergency
alternatives at
same airport

Emergency alternatives
also at nearby airports

Fuel Plan

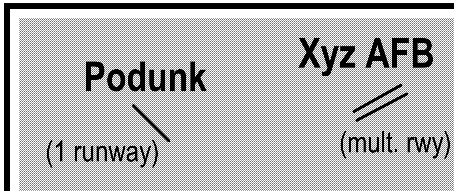
Emergency Plan



Emergency
alternatives at
same airport

Fuel Plan

Emergency Plan



Emergency
requires going
to other airport

Fuel Plan

Emergency Plan

When Does an Airport Require Emergency Fuel?
No Safe Landing Alternatives

Podunk
(1 long rwy, any others are short)

Emergency requires going to other airport (none available nearby)

Fuel Plan
=
Emergency Plan

Other Hub
(mult. long rwy)

Emergency alternatives at same airport but high traffic density vs. total airport capacity

Fuel Plan
=
Emergency Plan

Other Hub
(mult. long rwy)

Emergency alternatives at same airport but high traffic density vs. total airport capacity

Fuel Plan
=
Emergency Plan

RAF Standard Update
Factors and Assumptions in Estimation of Hold Time Savings

- **Current RAF: Previously computed to an equivalent of Alternate = NONE + 80**
- **Weather facts: Index shows 50% perfect Alternate = NONE weather; 35% is mediocre, 15% diversion weather.**
- **Weather used: Conservatively judged down to 35% perfect Alternate = NONE weather; 35% mediocre, 30% diversion weather.**
- **Alternate = NONE Hold time result: Weighted average of 41 minutes hold**
- **Mediocre weather Hold time result: Weighted average of 23 minutes hold**
- **Bad weather Hold time result: Assume average of 45 minutes hold**
- **Alternate distance: Assumed mediocre weather alternate distance of 30 minutes, bad weather distance of 40 minutes**
- **Hold time computation: Above figures provide perfect weather equivalent of Alternate = NONE + 41; mediocre weather of Alternate = NONE + 53; bad weather of Alternate = NONE + 85. This is what produces the overall equivalent of Alternate = NONE + 58 for all flights averaged, providing a 22 minute reduction**

RAF Standard Update
Factors and Assumptions in Estimation of Dollar Savings

- **Projected RAF: Previously computed to an equivalent of Alternate = NONE + 58**
- **RAF reduction computation:**
  - **Used 1990 average stage lengths for each fleet type.**
  - **Computed flight plans for equivalent average stage length flights with and without an extra 22 minutes of Hold time. Used reduction in RAF for further computations**
- **M & E Plans Book Method: Used May 8, 1991 M & E Plans Book to compute savings based on RAF reductions as payload reductions. Computation produced result of savings of <u>$24 million per year</u>, even without including smaller fleets of 59 aircraft total.**
- **Flight plans method: Computed additional flight plans with reduced payload due to reduced RAF. Tweaked until all altitudes the same, etc. Computation produced result of savings of <u>$18 million per year</u>, even without including smaller fleets of 59 aircraft total.**