

**C/AFT
European
Datalink Investment Analysis**

**C/AFT All Airline Meeting
October 13, 1999**

Overview

- * Introduction & Assumptions
- * AOC Situation
- * ATC Situation
- * Model Inputs
- * Results
- * Conclusions

Introduction

- * C/AFT airlines agree that future system capacity is a primary driver for global airspace system changes**
- * C/AFT proposes incremental operational enhancements that can be enabled by CNS technologies**
- * Data Link is primary candidate enabler for delay reduction**

Assumptions

- ✦ C/AFT EURO is not an alternatives analysis, Data Link is the only technology enabler considered.
- ✦ Analysis is performed for High Traffic Level Areas of Europe.
- ✦ Based on airline point of view (airlines as an industry, not a single airline).
- ✦ Air traffic growth drives ATC infrastructure readiness, which drives air and ground equipage.
- ✦ AOC frequency congestion drives equipage (Stage 1)
- ✦ Evaluates transition from character-based ACARS AOC to ATN-based AOC and ATC operations.
- ✦ Evaluates transition from non-datalink AOC operations to ATN-based AOC and ATC operations.
- ✦ Both ATC and AOC benefits considered.

European AOC Issues

- * **Approx. 50% of airplanes use data link AOC**
 - frequency congestion problems
- * **Those not using AOC data link may equip for VDL-2 for both AOC and ATC benefits**
- * **No more frequencies available for ACARS**
 - there is political pressure by European Frequency Management group to make better utilization of frequencies
 - much more serious situation than in US
 - ATC will be using up channels freed by 8.33, no chance for growth for ACARS
- * **Two frequencies that were designated ACARS freq's will have to go to VDL-2 2003-2005**
 - More congestion for ACARS, bad for bandwidth

European AOC Issues, continued

- ✦ Number of airplanes equipped with AOC is growing (SITA)
- ✦ More applications, AOC traffic is growing per airplane
- ✦ Potential for very high growth in AOC traffic as more airlines equip
 - between 20-25% annual growth
 - Airlines rely on AOC more than before, AOC is becoming backbone of Operational Control organization. Airlines will be relying more on ACARS data. Punctual operation is driver.
- ✦ “SITA is convinced VDL is required to avert ACARS service breakdown in 2003/4 timeframe.”

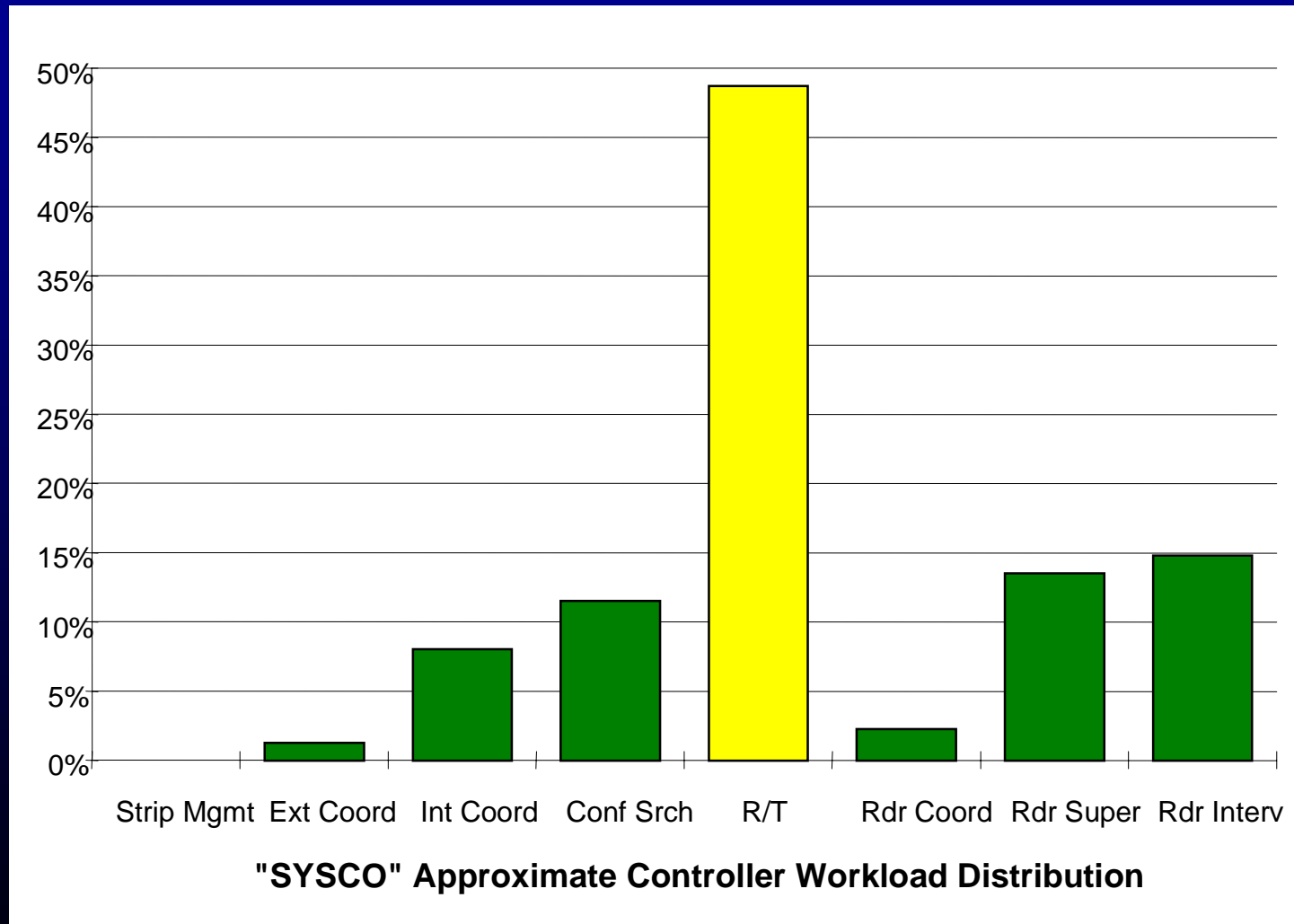
European ATC Situation

- ★ **Current delay situation is very bad, need to do something immediately**
 - airlines want to reduce the amount of delay that exists today
 - need to maintain acceptable levels of delay (see performance target document)
 - FAP document has 5 year forecast, update will be ready in October
 - Current estimate for 2005 is 33.5 minutes average delay per flight
- ★ **Link 2000+ using business case to quantify benefits of ATS data link.**
- ★ **PETAL-II trials in Europe evaluate data link operational issues**
- ★ **Eurocontrol doing data link simulation (L2KBC)**
 - studying potential capacity gains by implementing ATS data link
 - preliminary results in October.

FAA's Data Link Program Based on ATN over VDL-2

- * Builds 1 and 1A are subset of PETAL-2**
- * Build 2 includes initial oceanic message support**
- * Build 2 has international scope**
 - Eurocontrol and European States requesting joint FAA collaboration to define follow-on data link implementation project.**
- * Build 2 follow-on activity expected to be key in setting the international standard for ATC data link in congested, highly developed airspace.**
- * Build 2 will define the beginning of the transition from FANS-1 to ATN.**

The First Step: Controller Communications Workload



C/AFT Modeling Process

Transition Logic Diagrams

- * C/AFT is proponent of incremental operational enhancements**
- * Transition Logic Diagrams**
 - separate diagram for each phase of operation
 - developed for both capacity and efficiency
 - operational enhancements “enabled” by technology or procedural improvements
- * C/AFT analysis focuses on capacity-related improvements**
 - Reduced separations
 - Additional routes

C/AFT Modeling Process Economic Model

*** Determines**

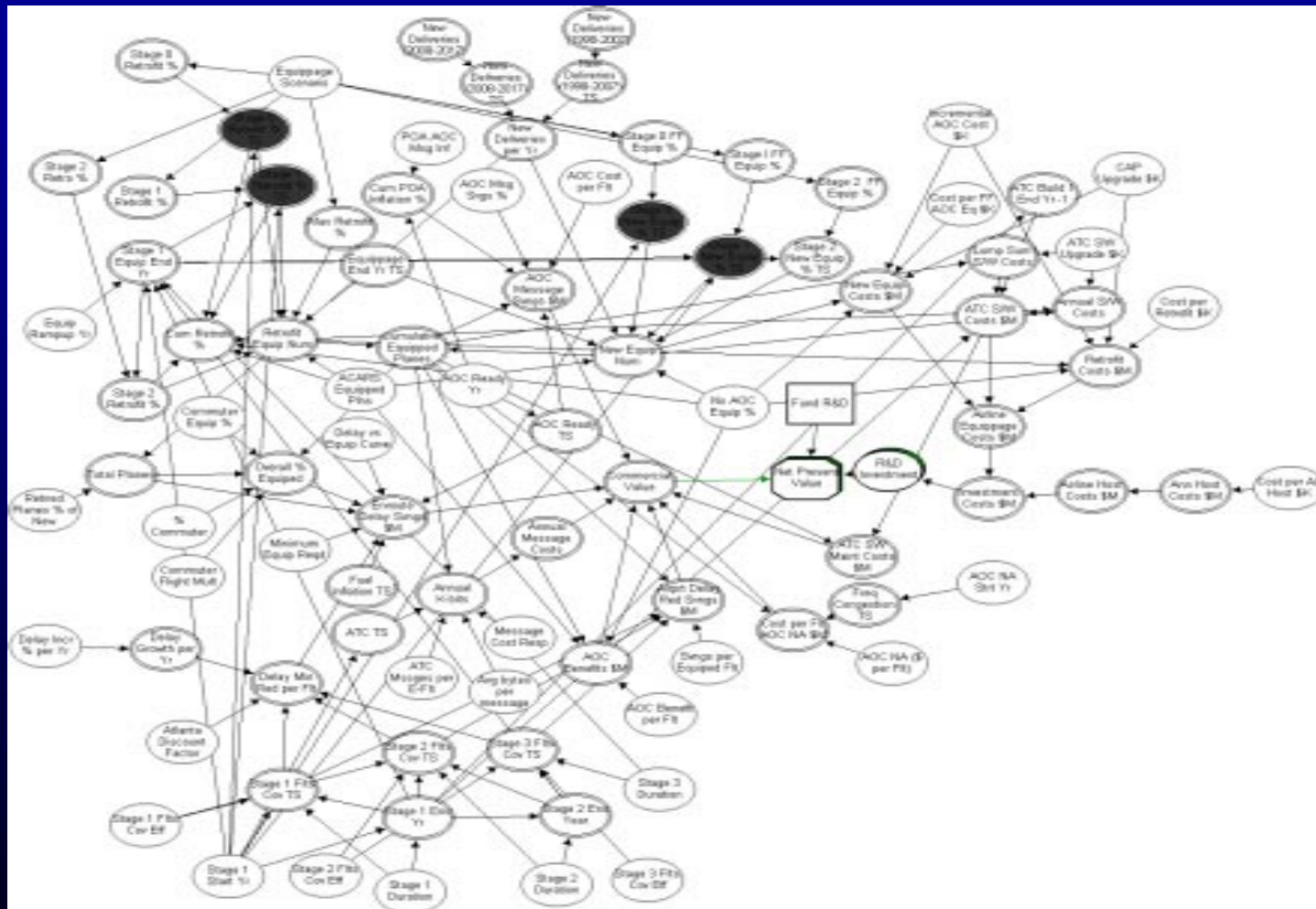
- **Costs**
- **Benefits (converted to dollars)**
- **Risk**
- **Rules**

*** Builds Deterministic Sensitivity Analysis**

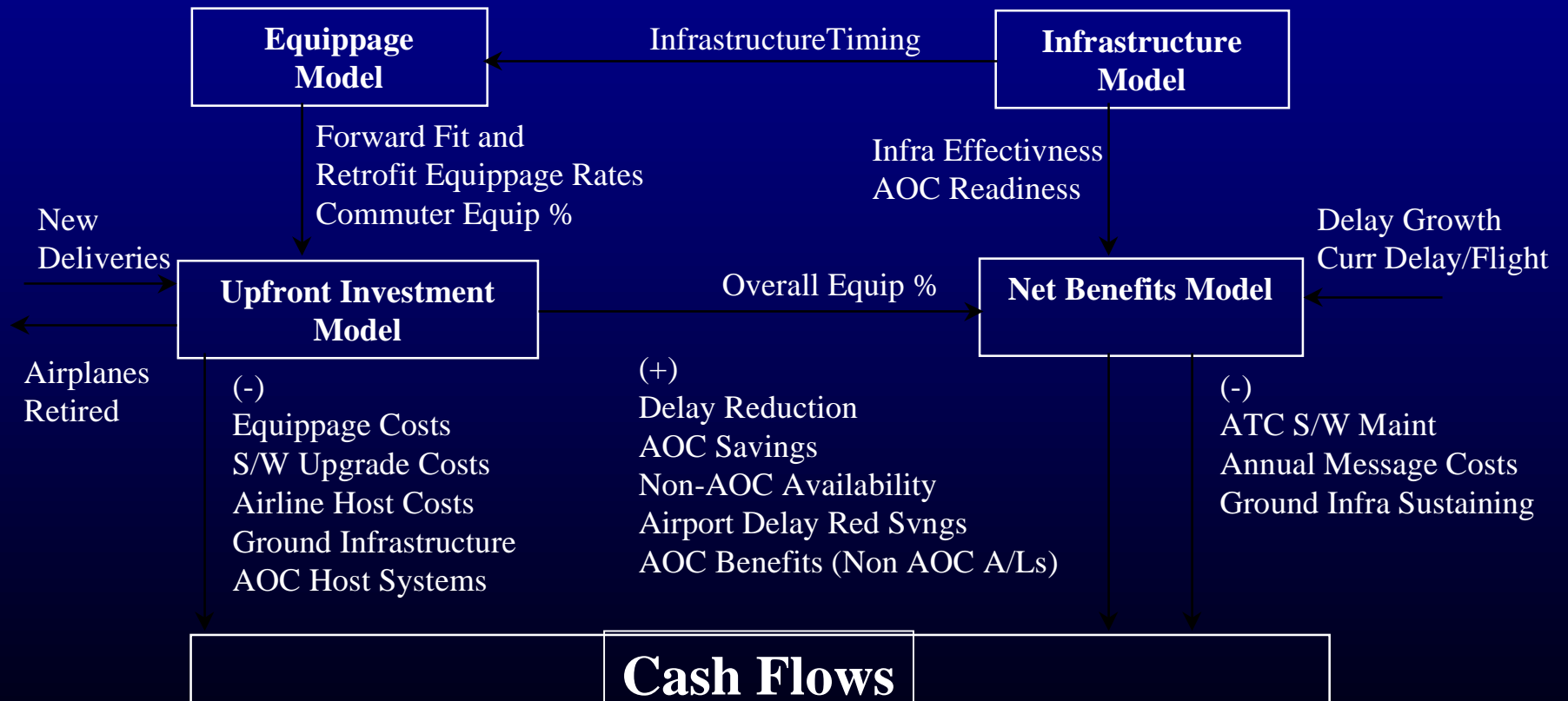
- **Identifies influence of each uncertainty on NPV**
- **Used to calculate overall risk and return**

European Datalink--Preliminary Results

Influence Diagram



Datalink Investment Model



European Model Inputs

Delay Growth Assumptions

- ★ Different growth rates at different times
- ★ Until 2005
 - High Delay Growth per Year (20%, 25%, 35%)
 - Based on Eurocontrol ATFM Delay variation 1997/1998
- ★ 2005 - 2010
 - Delay growth slows down due to planned operational improvements
 - Delay Growth per Year 5%, 10%, 15%
- ★ 2010 - 2020
 - Assume delay remains constant at 2010 levels

European Model Inputs

Traffic Growth

- * **Costs and benefits calculated for 70+ seat airplanes**
- * **New deliveries are added and retiring planes are subtracted each model year**

European Model Inputs Variables

- * Start Year of Model 2000
- * Final Year for Equipage = 2015
- * Final Year for Benefit = 2020
- * Discount Rate = 12%
- * Inflation Rate = 2%
- * Percentage of Fuel-related DOC = 15%
- * Fuel inflation rate = 5%
- * Direct Operating Cost (DOC) per minute is range of 11 - 33 Euros
 - Does not include amortization of costs for ownership

European ATC Benefits

- ✦ Will be looking at multiple services affecting multiple phases of flight
- ✦ First stage is local services at airports
 - Departure Clearance and Digital-ATIS
 - VDL-2 is cheaper than VHF
 - Benefit will also apply to new users
- ✦ Second and third stages will be area-wide services in en-route
 - ATC Communications Management
 - ATC Clearance
 - ATC Microphone Check
 - Controller Access Parameters
 - Note: Downstream Clearance is not included in the model.

European Infrastructure Assumptions

- ★ VDL Mode 2 AOC infrastructure assumed to be ready at start of model
- ★ Stage 1 Airport Services ready at start of model.
 - High Forward Fit rate for AOC and ATC benefits
 - Low Retrofit Rate
- ★ Stage 2 range of en-route infrastructure readiness: 2004 - 2007
 - Continued Forward Fit
 - Increased Retrofit Rate

European Model Inputs

Costs

- ★ ATM Infrastructure costs are included
- ★ Equipment costs assumes avionics/flight deck impact: CMU, VDR, wiring, and dedicated display
- ★ Maintenance costs: 10% per year of ATC upgrade cost
- ★ Message costs:
 - \$.28 0-1 Million Kbits;
 - \$.24 1-4 Million Kbits;
 - \$.16 4-8;
 - \$.08 8-15;

Model Inputs

AOC Benefits

* AOC Non-Availability

- Cost to an airline of not having full ACARS capability (\$16, \$32, \$48 per flight)

* AOC message cost reduction

- per-bit savings and message length reduction

* AOC Cost Avoidance for VDL-2 equipage

- Low speed ACARS Data Link will be more costly on a per message basis.

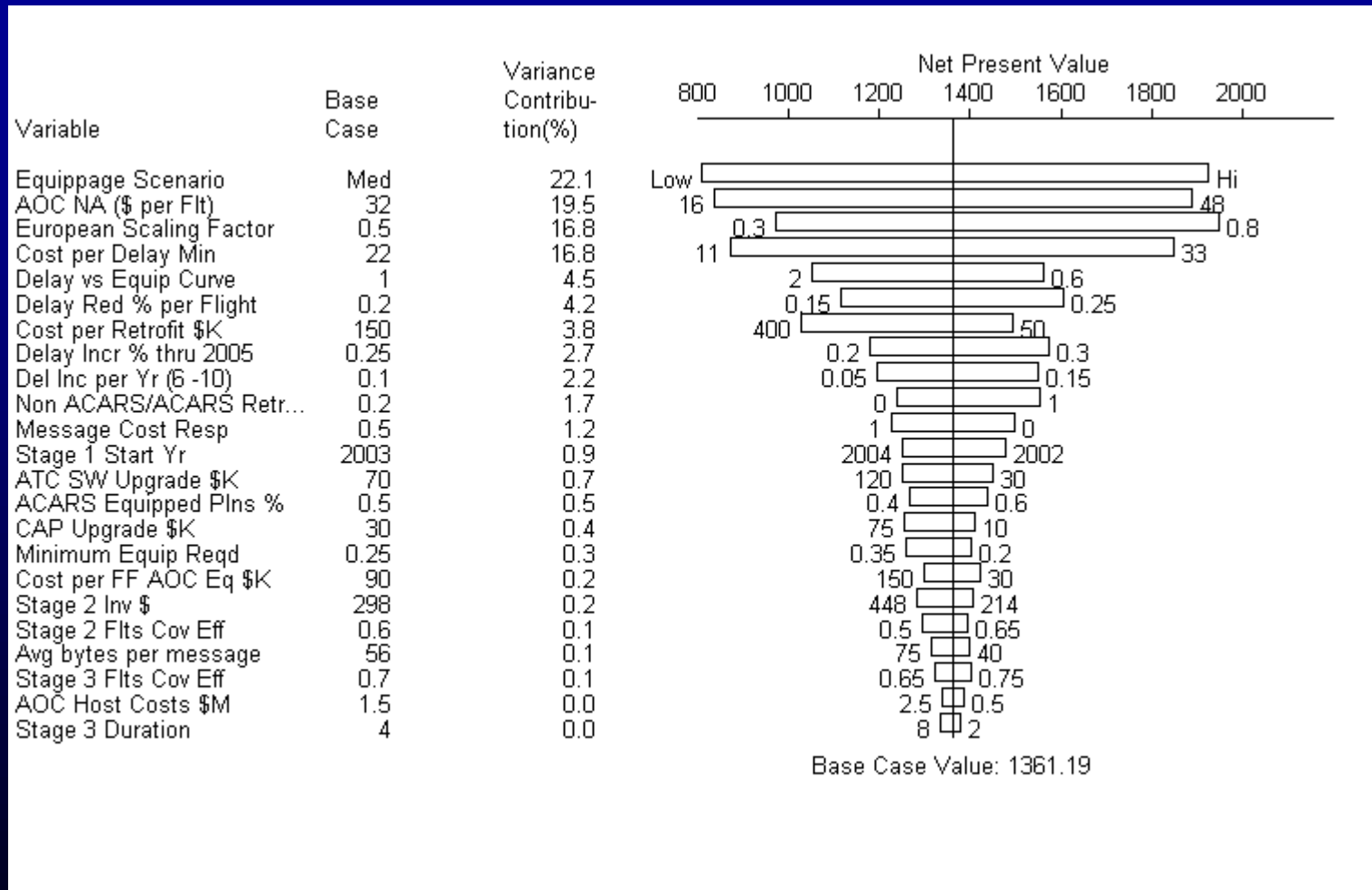
Datalink Model

ATC Benefits

- * Delay reduction benefits applied to all airplanes, not just those equipped**
- * ATC Delay Reduction Benefit**
 - Based on Preliminary Data form Eurocontrol Bretigny simulation
- * Uses the following variables:**
 - Delay reduction
 - Equipage rate
 - Delay growth per year
- * Delay reduction benefits are dependent on equipage levels**

European Datalink--Preliminary Results

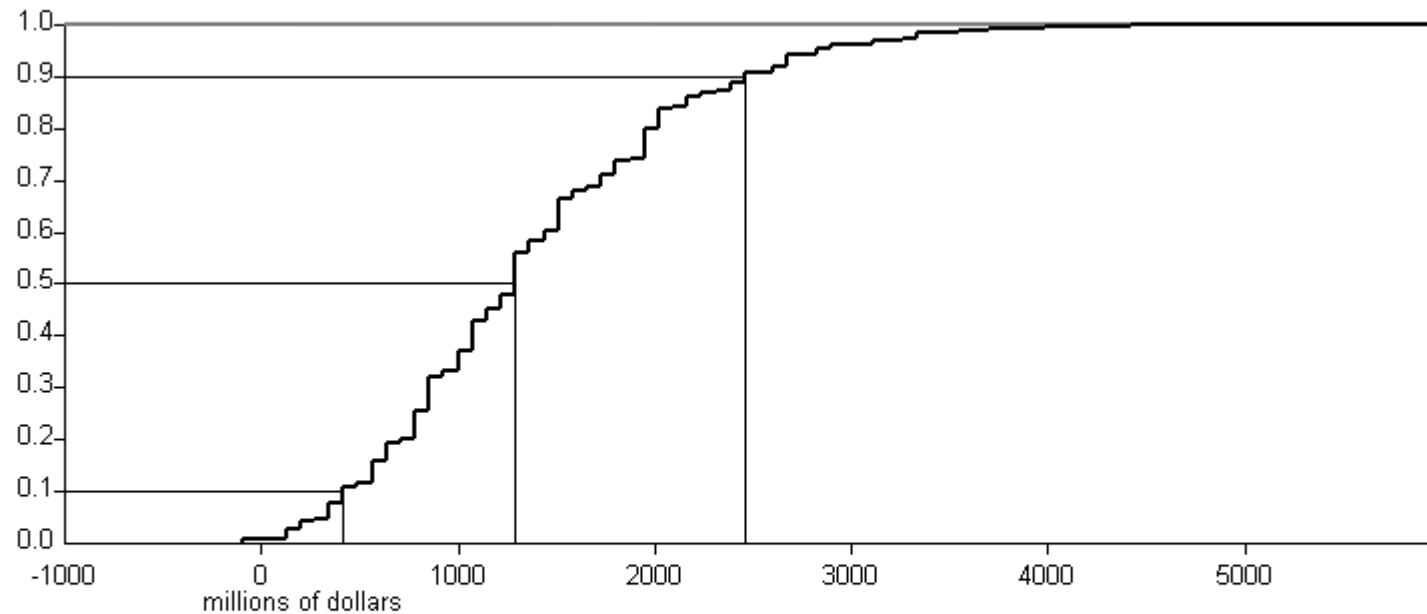
Tornado Diagram



European Datalink--Preliminary Results

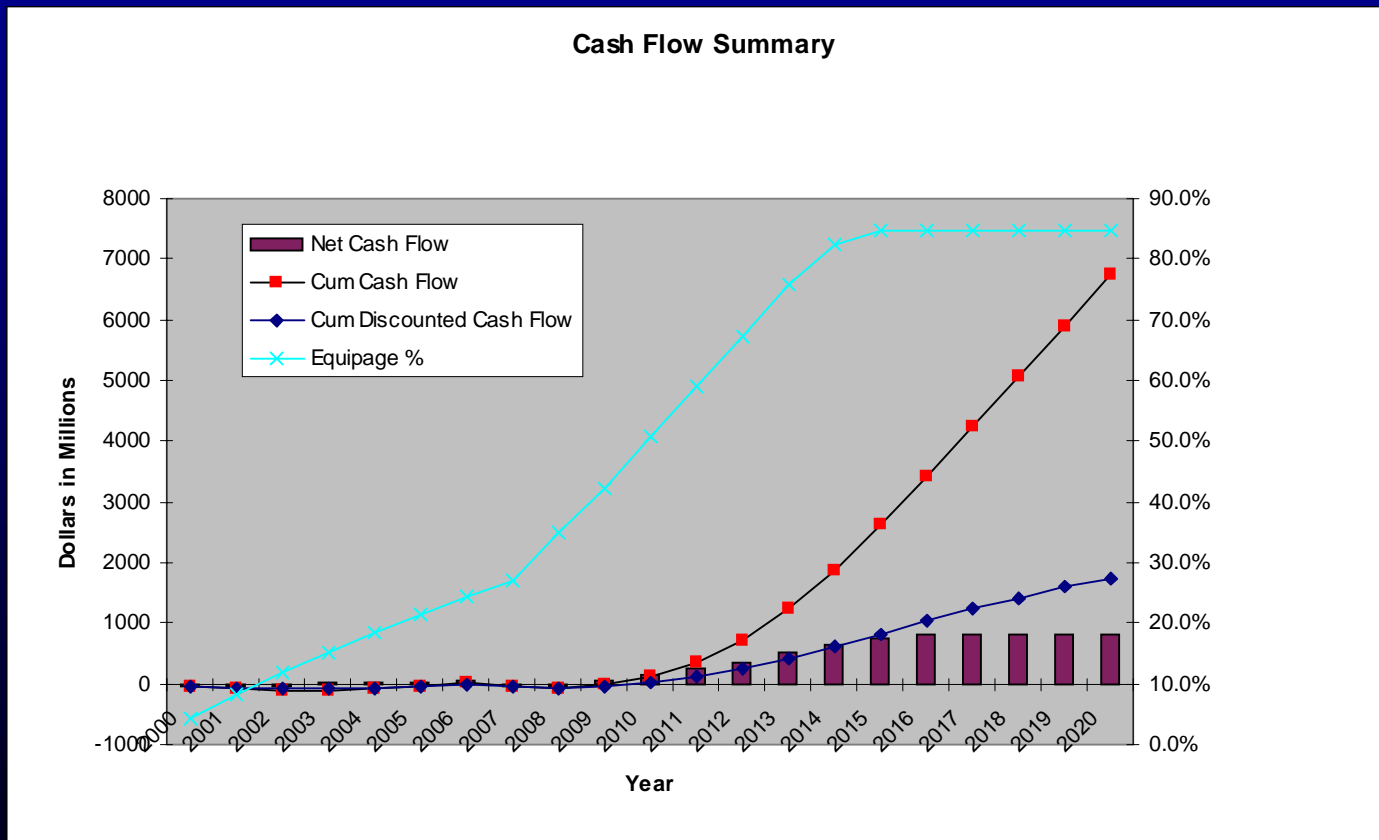
Cumulative Probability Distribution

Cumulative Probability

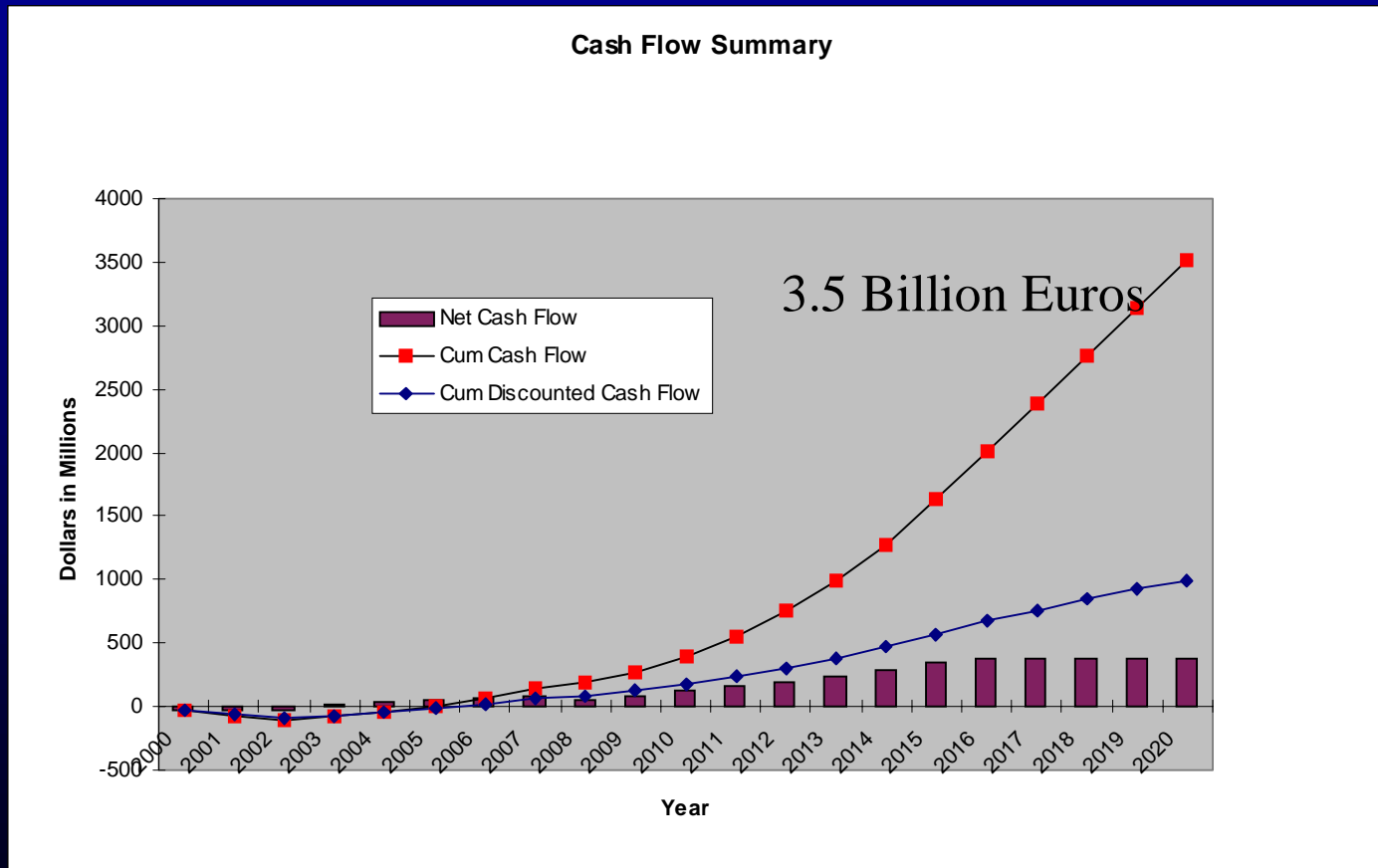


● Net Present Value Mean: 1379.62 SD: 793.88 10-50-90: 418.96/1293.20/2456.94

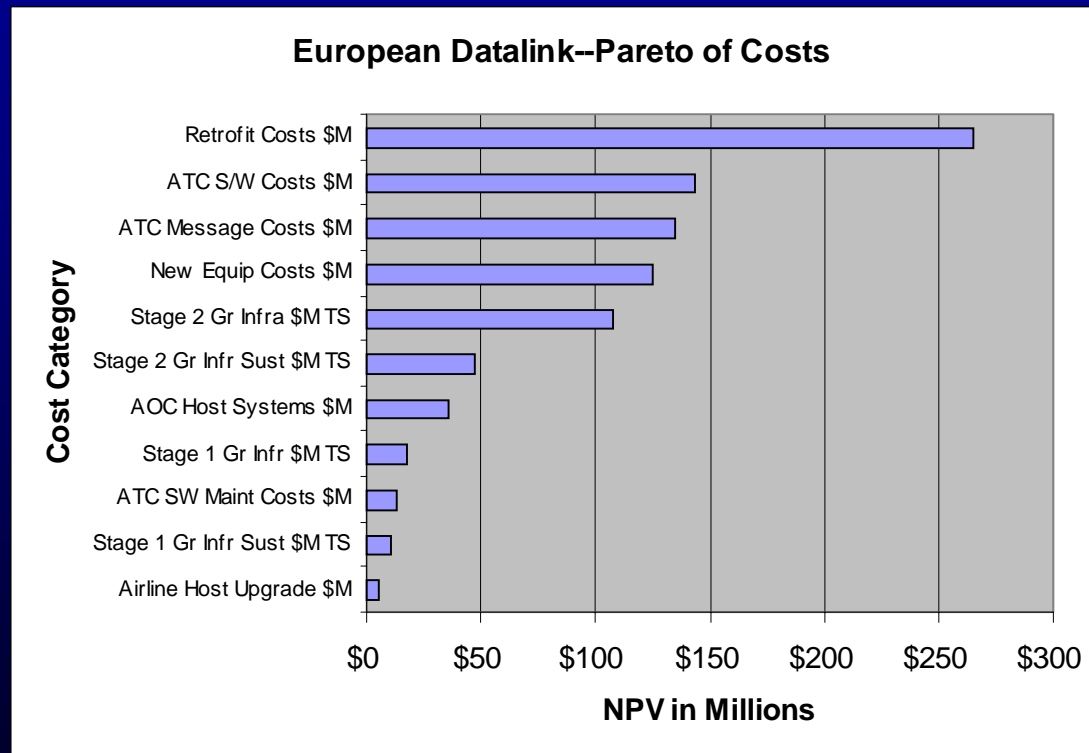
Cash Flow Summary with Equipage



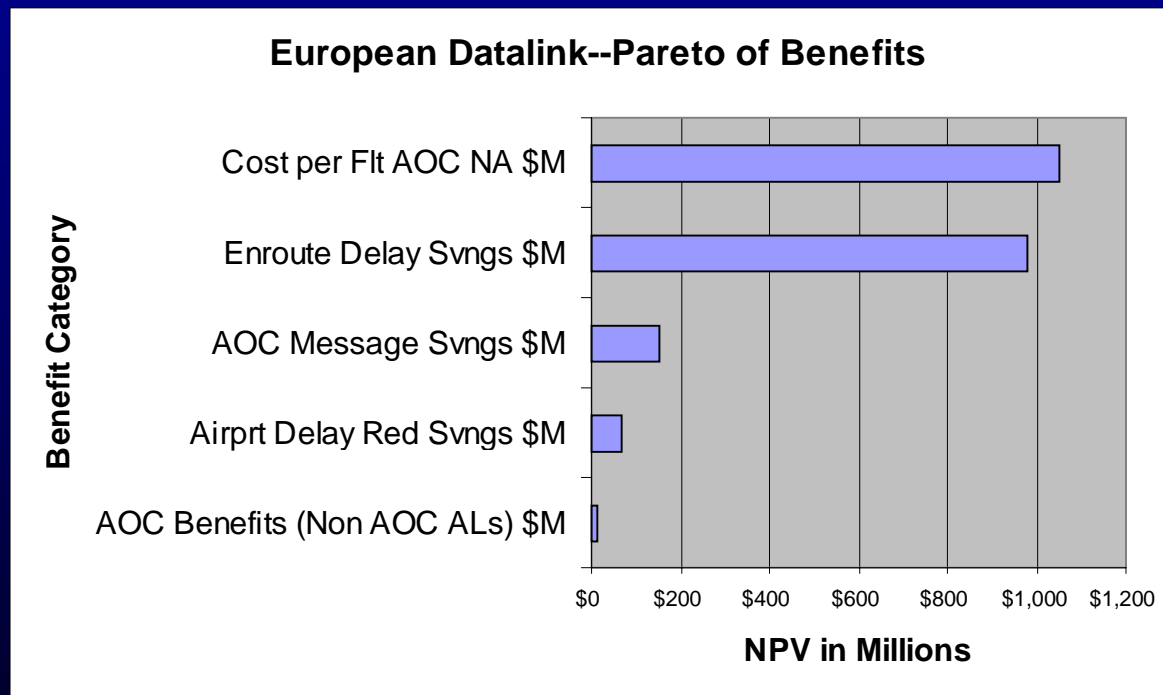
AOC Only--Cash Flow Summary



Costs Breakdown



Benefit Breakdown



European Data Link Results

The Numbers

- * Expected Net Present Value is 1.4 Billion Euros
- * AOC Only Expected Net Present Value is 742 Million Euros
- * Benefit to Cost Ratio is 3.0
- * Internal Rate of Return is 39%

Conclusions

★ Benefits of AOC enable equipage

- The value of maintaining AOC data link capability is an important cost-avoidance driver

★ Risks associated with going to ATC data link are mitigated by the need to preserve AOC

- Variables that need the most attention influence ATC benefits

★ Cumulative cash flow exhibits long-term infrastructure investments (longer term ROI)

★ ATC infrastructure readiness combined with equipage levels determines overall benefit

C/AFT European Data Link What Next?

- * Waiting for final results from Eurocontrol Bretigny simulation.**
- * Will issue final results of C/AFT model once simulation results are included**