



## The Magic of Measuring: AHP & APF



**A “How To Guide” for the Safety Exercise**

**EUROCONTROL ESP & Aloft Aviation  
October 2010**

# The Challenge: Tangible vs. Intangible!



- Incorporate the impact (importance and influence) of many different factors and elements into a decision.
- Determine a quantifiable value of *intangible* elements to determine their *influence* or importance to the overall decision.
- AHP Methodology: Allows for the mathematical measurement of the psychology of human judgment-both individually and as a group.

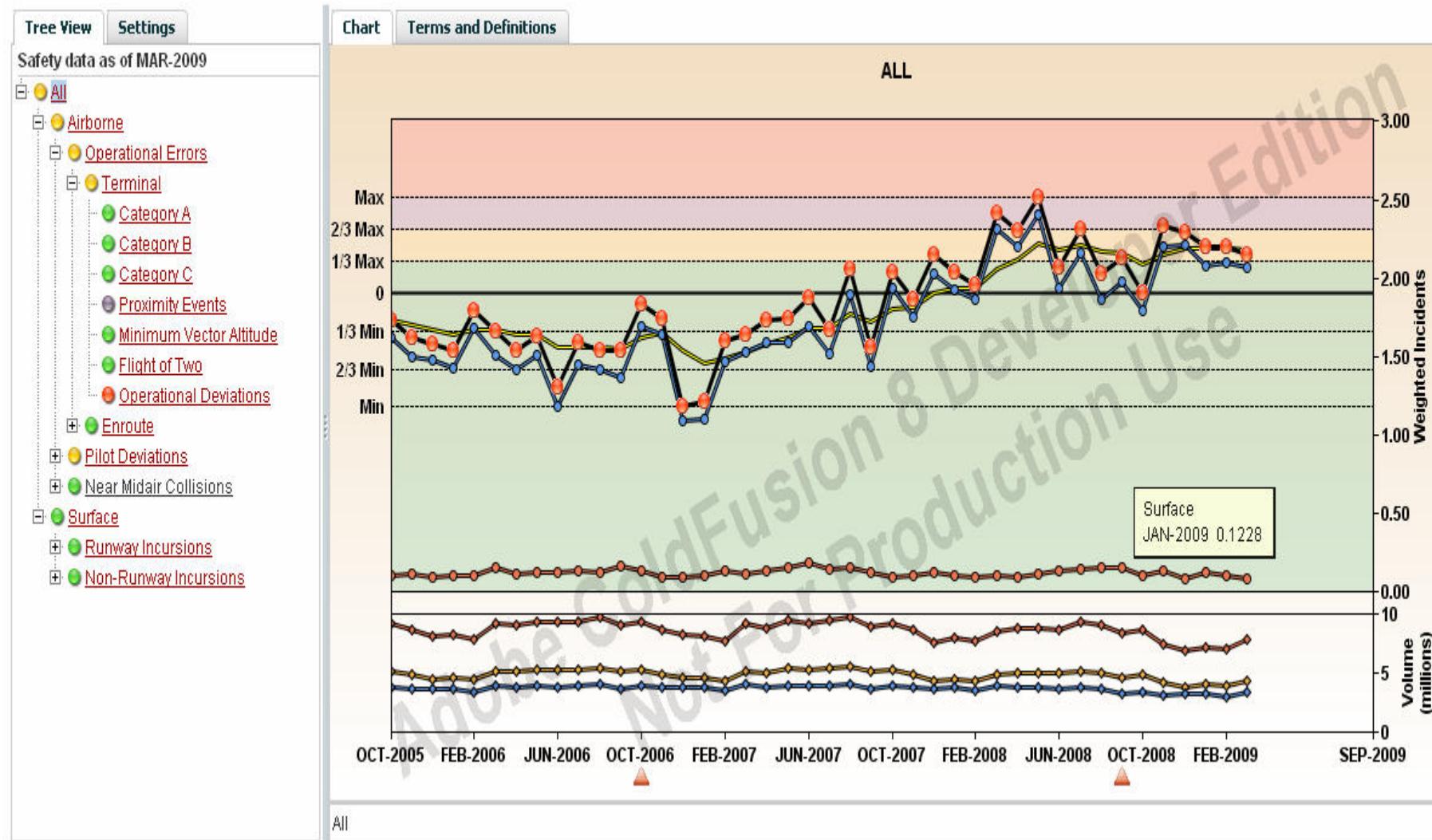
# A Look At “Old” vs. “New” Data Displays Here, The “Classic” Data Presentation



		2000	2004	Difference
<b>Aircraft Accidents</b>				
Air Carrier		56	29	-27
Air Taxi/Commuter		92	73	-19
GA		1835	1614	-221
NMAC		237	145	-92
PDs		1919	2628	709
OE		1139	1216	77
VPD		547	263	-284
<b>Surface Incidents</b>		1396	882	-514
Runway incursions		426	310	-116
<b>Aircraft Operations</b>				
		46,056,000	46,762,000	706,000
Air Carrier		25,080,000	24,278,000	-802,000
Air Taxi/Commuter		8,164,000	10,029,000	1,865,000
GA		8,634,000	8,374,000	-260,000
Military		4,178,000	4,071,000	-107,000
<b>Aircraft Hours</b>		318,000,000	273,000,000	-45,000,000

Can We Really Measure Total Organizational Change?

# An Example Of The “New” Data Display Methodology



# From Trending to Diagnostics & Drill Down: How the APF Presents Selected Raw Data



Tree View   Settings

Headquarters data as of MAR-2009

- Efficiency APF(e)
  - Enroute
  - Terminal (OEP 35)
    - Western Terminal
    - Central Terminal
  - Eastern Terminal
    - Delays
    - Volume
    - Weather
    - Equipment
    - Runway
    - Other
  - Available Capacity
  - WITI

Chart   Terms and Definitions

Diagnostic Charts for MAR-2009

Charts represent data when available and may have incomplete or partial data.

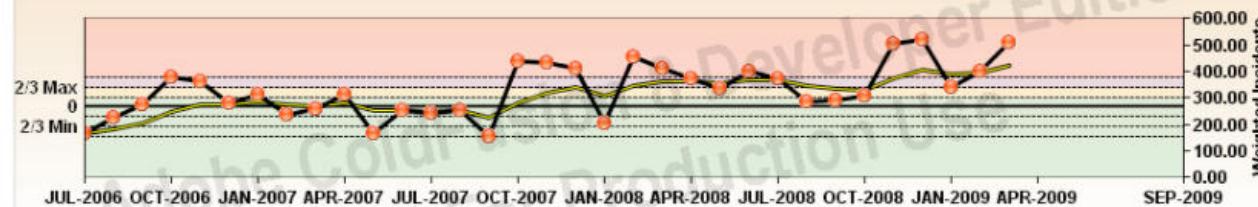
**Facilities**  
Total: 17,683  
ATL 7,362

**GDP**  
Total: 62

**GS**  
Total: 128

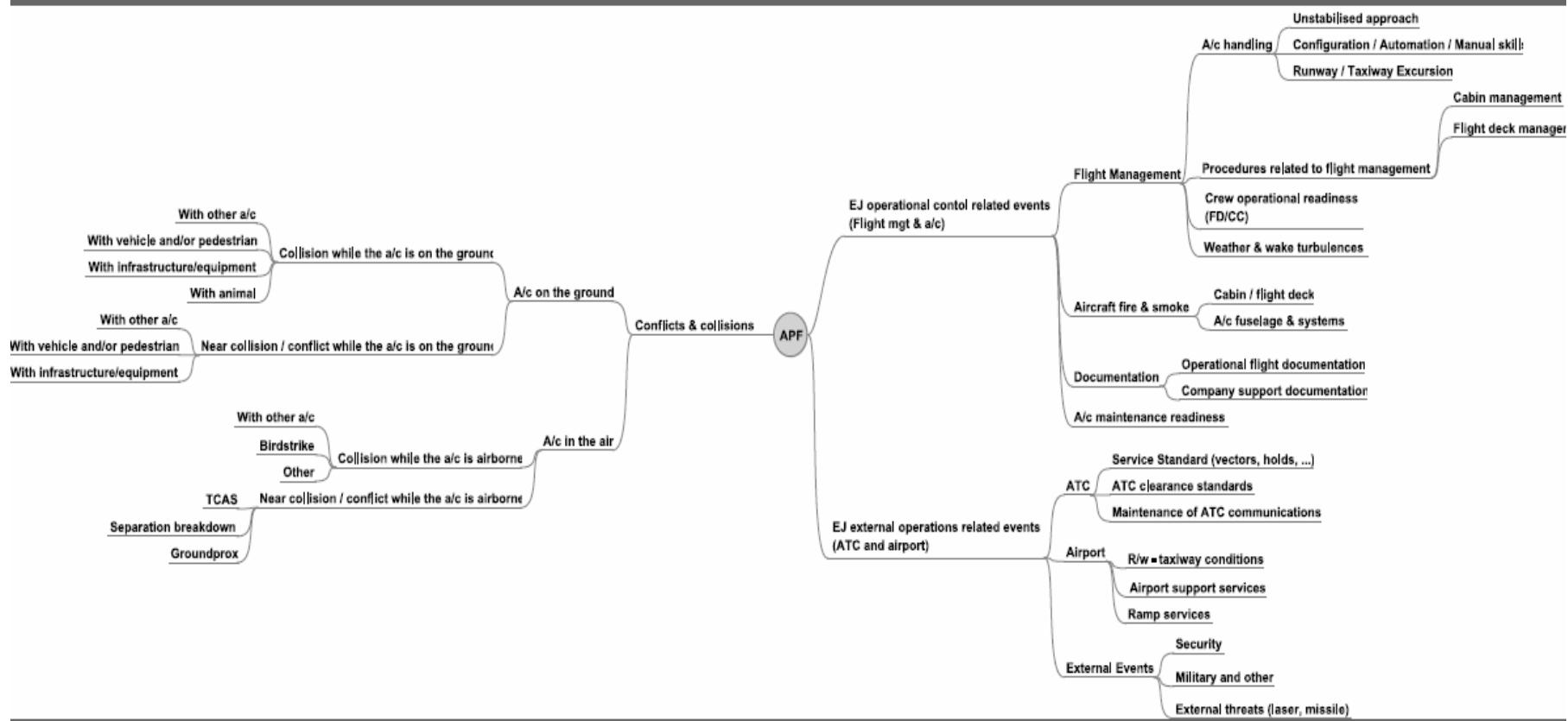
**Terminal WITI**  
Total: 31

**WEATHER**

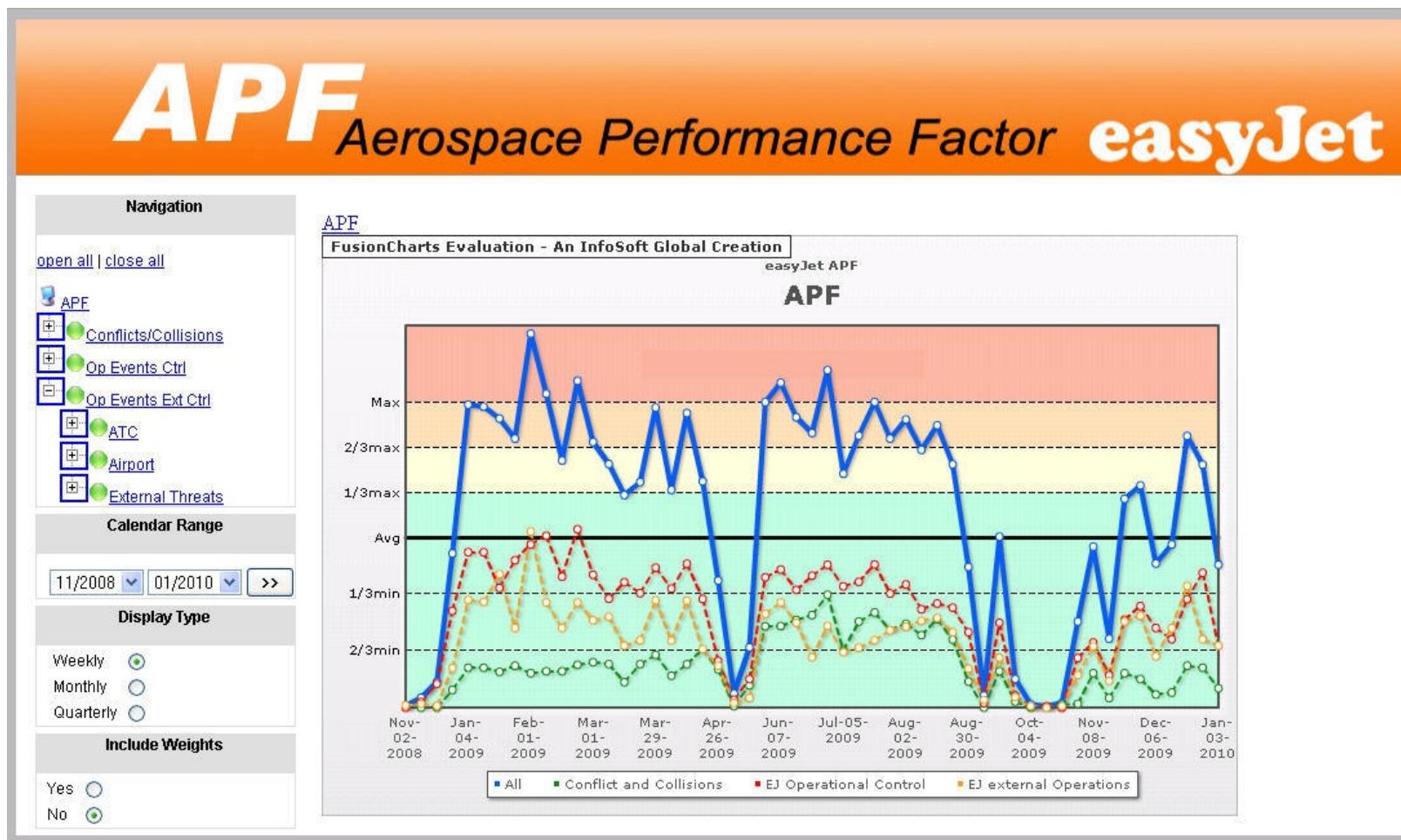


Efficiency APF(e) ▶ Terminal (OEP 35) ▶ Eastern Terminal ▶ Delays ▶ Weather

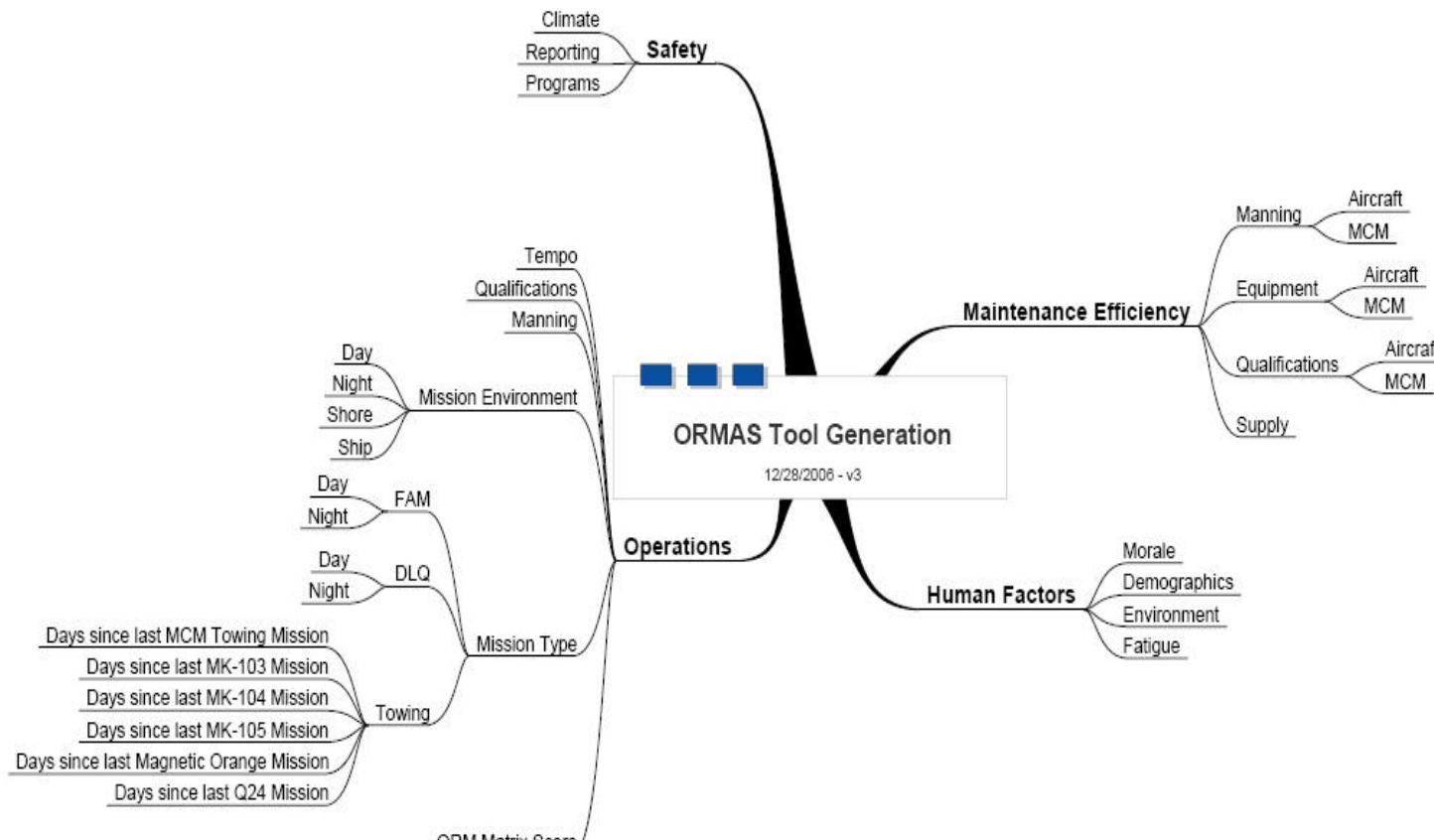
# easyJet Flight Operations- Original Mindmap



# Display of Airline Data (Developmental Data)

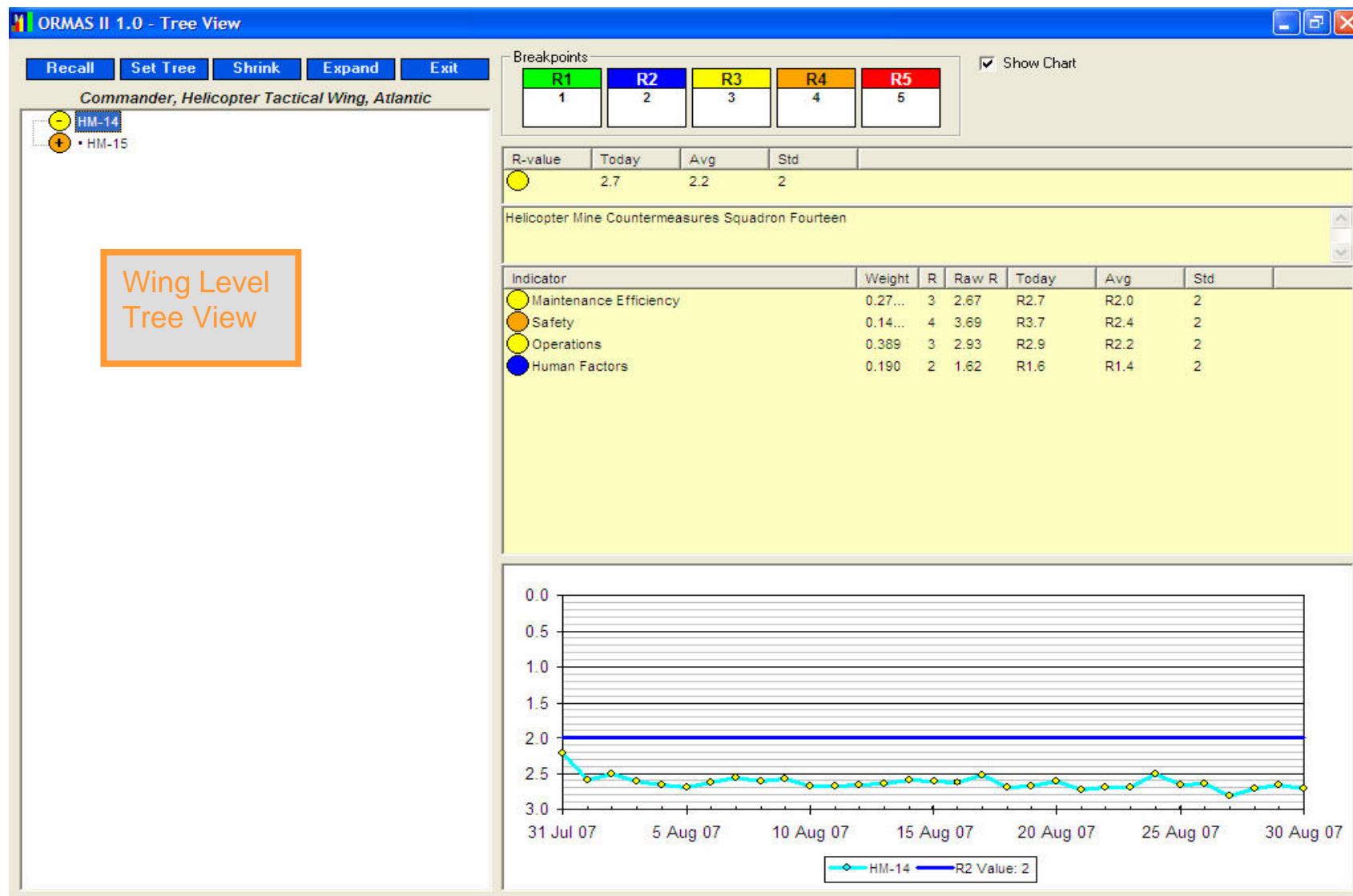


# First US Navy Mindmap: Complex & “Lesson’s Learned”



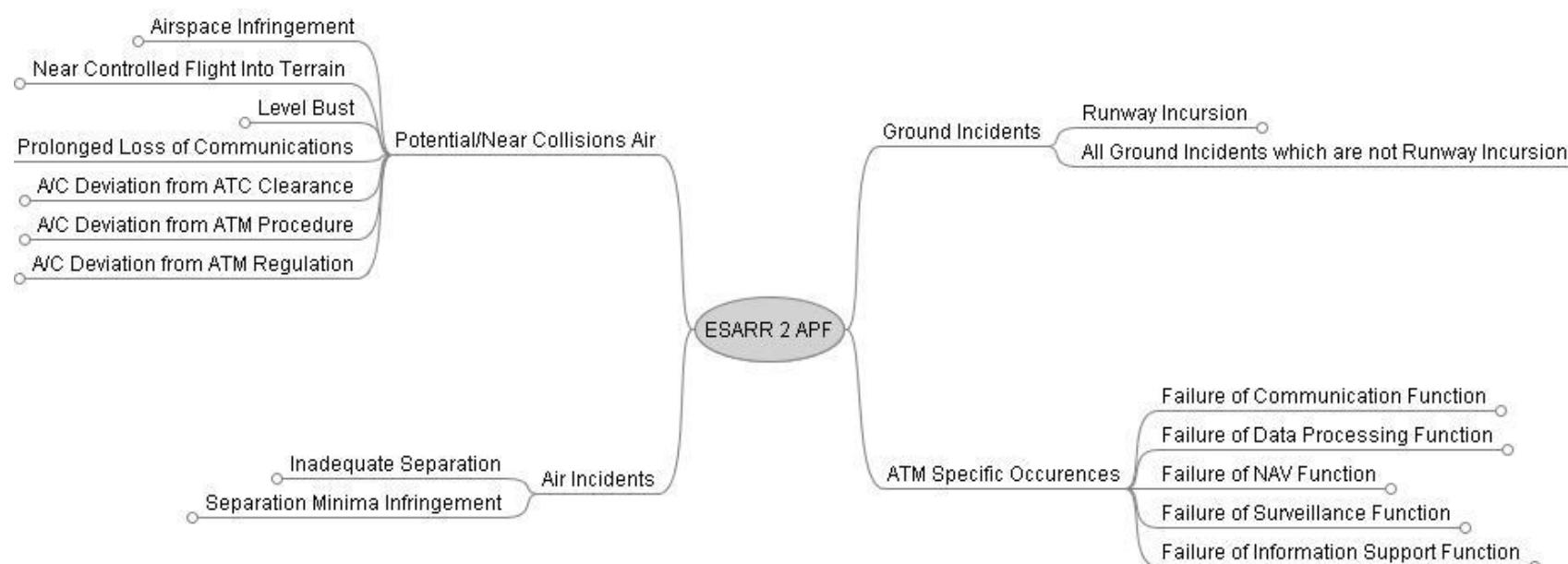
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# US Navy ORMAS Risk Tool: Based on APF Concepts

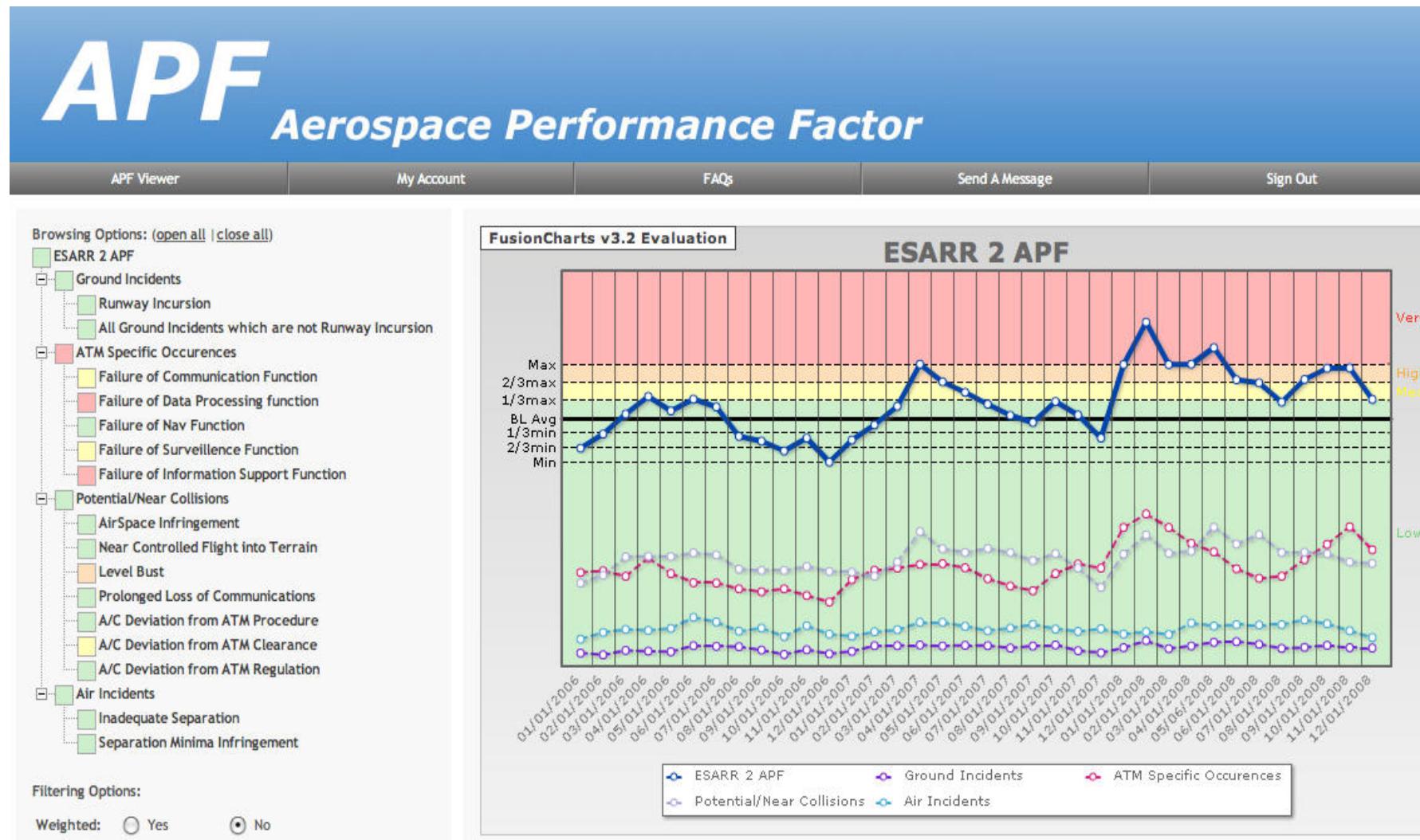


# Current EUROCONTROL Mindmap

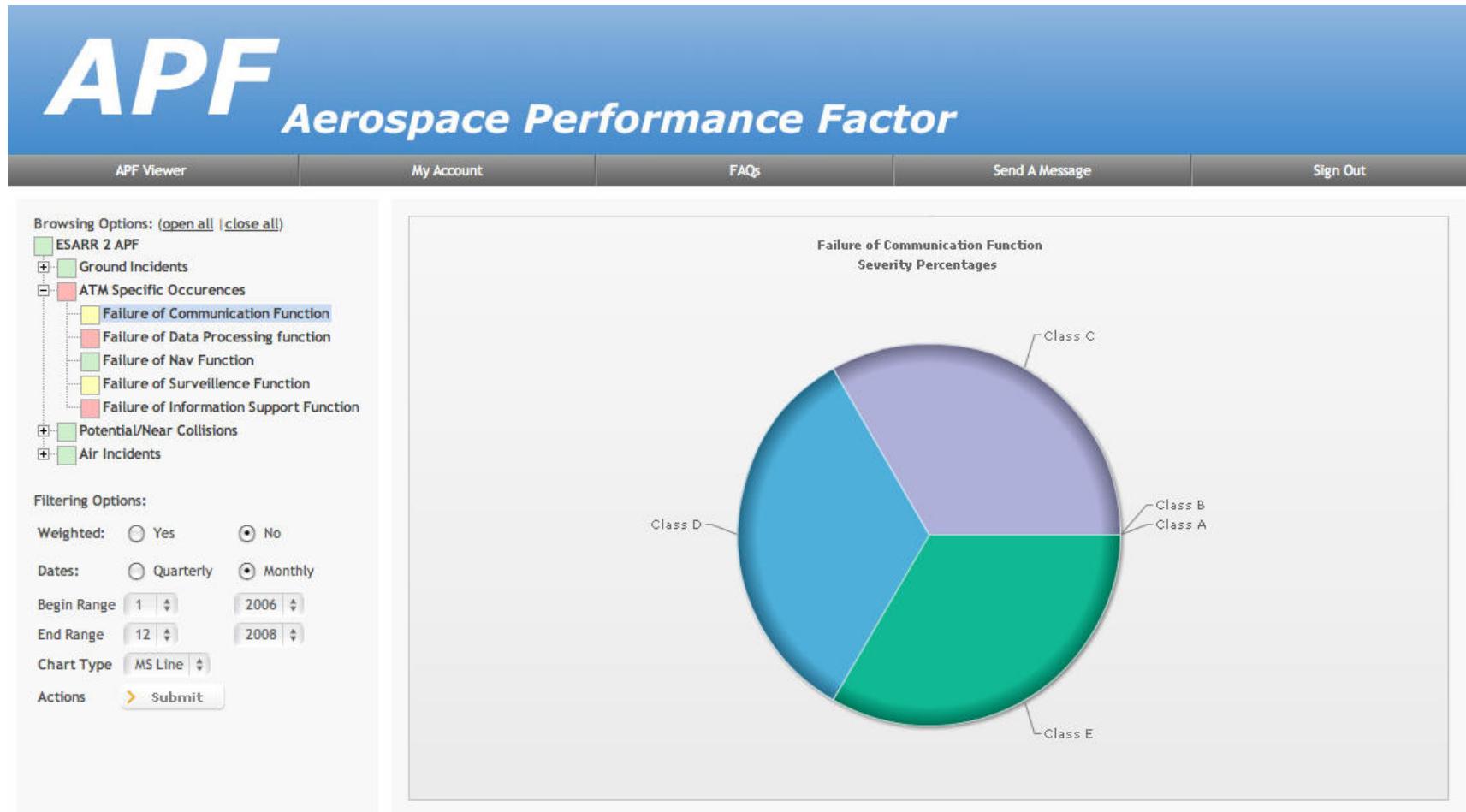
Note The Symmetrical Shape:  
~A Design Goal When Possible~



# An Example Of The “New” Data Display Methodology Development



# From Trending to Diagnostics & Drill Down: How the APF Presents Selected Raw Data



# Intangible Elements: You Will Meet In The Exercise-



- *Flight Efficiency for the Airlines*
- *Sector Capacity*
- *Cost / Benefit for ANSPs and Airlines*
- *Political and Social Pressures*
- *Environment*
- *Safety*

# Weighting the Data Elements

## The Analytic Hierarchy Process (AHP)



- Analytic Hierarchy Process:
  - Developed by Dr. Thomas Saaty to use multiple factors involved in complex decisions.
  - Used in original SALT Treaty discussions.
  - A “blend” of mathematics and the psychology of measuring intangibles.
  - Uses pair-wise comparisons.
- For additional reading go to:  
[http://en.wikipedia.org/wiki/Analytic\\_Hierarchy\\_Process](http://en.wikipedia.org/wiki/Analytic_Hierarchy_Process)

# The Classic AHP Example



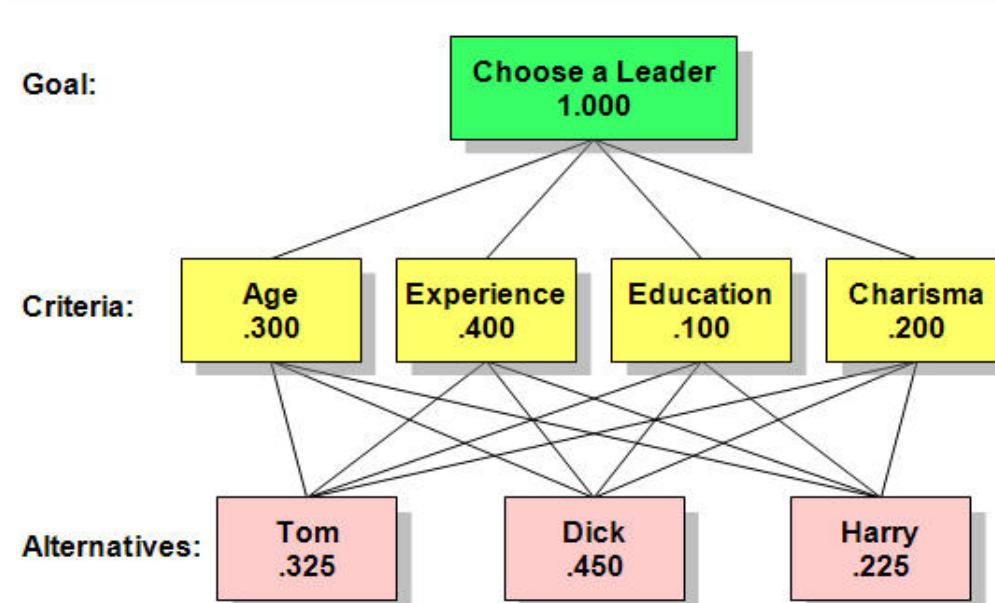
## AHP: Selecting a Leader



Tom

Dick

Harry



# Demo Of AHP Process



- Important Aspects For Selecting A Family Car (Goal)
  - Body Type (Element)
    - 2-Door (sub criteria)
    - 4-Door (sub criteria)
    - Hatchback
  - Engine Type
    - Gasoline
    - Diesel
    - Hybrid
  - Transmission Type
    - Manual Transmission
    - Automatic Transmission
  - Manufacturer Type
    - European Manufacture
    - Asian Manufacture
    - American Manufacture

# Consistency vs. Inconsistency



- Consistency simply means your answers are following the same relative pattern
  - Consistency = If  $A > B$  and  $B > C$ , then  $A > C$
  - Inconsistency = If  $A > B$  and  $B > C$ , you answer  $C > A$
- Inconsistency can happen for a number of reasons:
  - Getting “lost” in the mindmap
  - “Clicking” in the wrong direction,
  - An unclear definition

# Advanced Tips For The Exercise

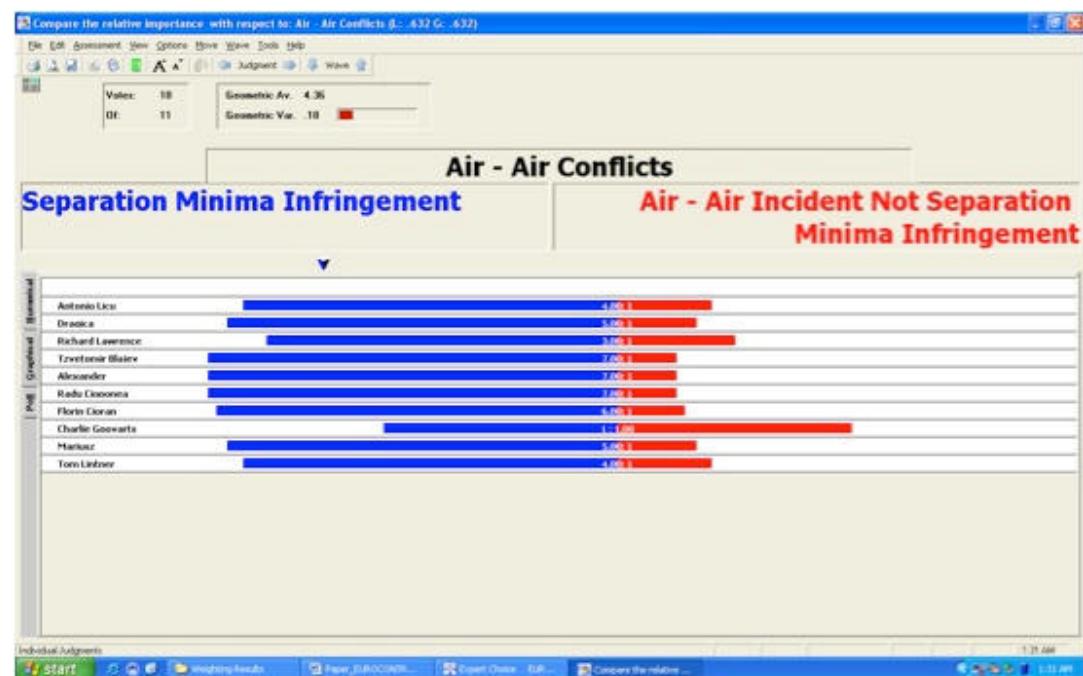


- Remember the goal question.
  - Applies to the primary goal and sub-set elements
- Go with your instinct!!! Shoot from the hip!!!
  - Don't think and debate with yourself! Depend on your experience!
  - If you ponder, you are instead assessing specific events, not taking a system-wide view.
- Understand “Inconsistency” but don't drive yourself crazy
- Enjoy the post-exercise discussion!
  - This is not designed to make someone change their mind. It's designed to make sure everyone understands the factors.

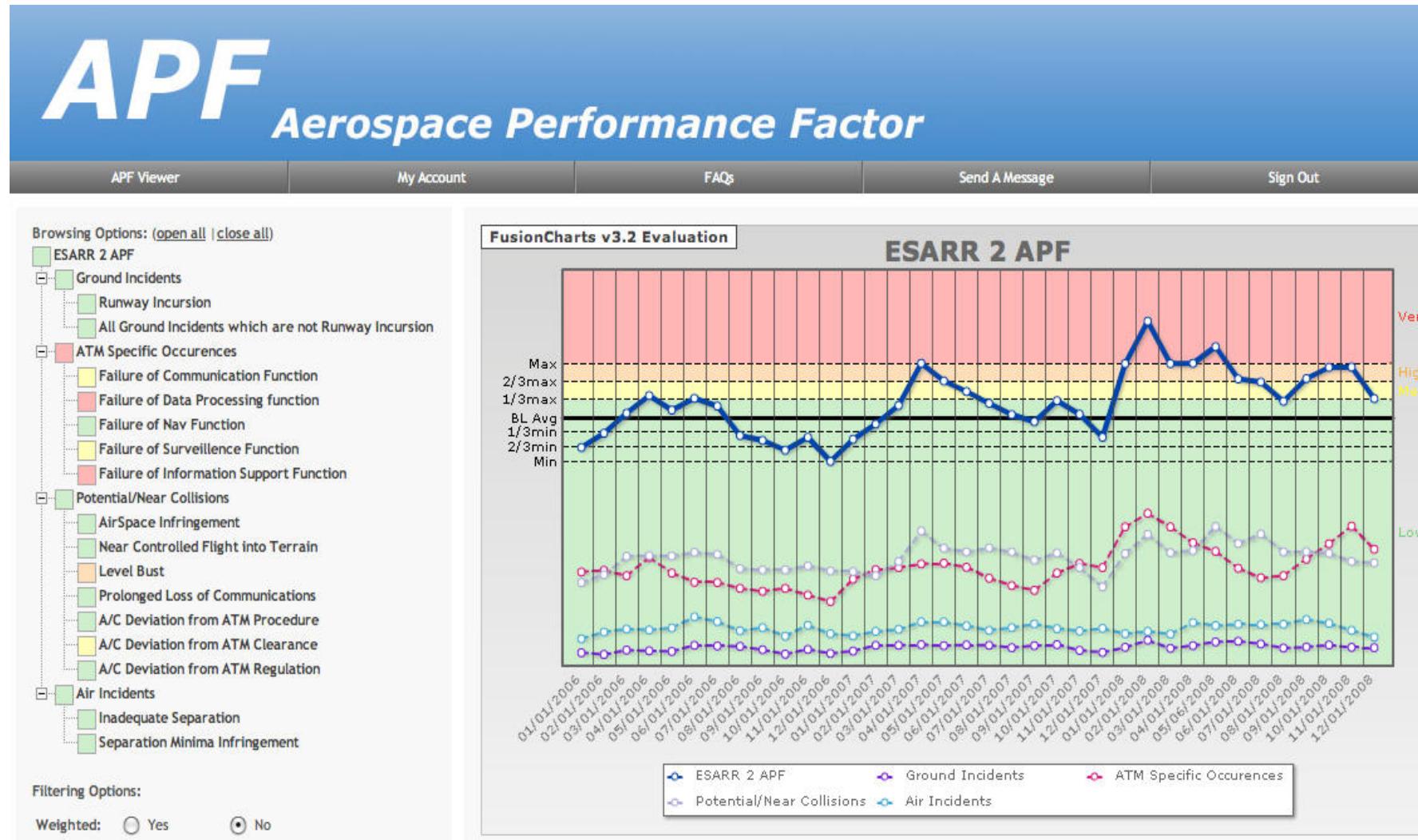
# Post Weighting Exercise Discussion- A Critical Element



- Group review & discussion
- Assess and understand conclusions



# The Results- A New Data Display Methodology, The APF!



# Now, Let's Select A Family Car...



- Important Aspects For Selecting A Family Car (Goal)
  - Body Type (Element)
    - 2-Door (sub criteria)
    - 4-Door (sub criteria)
    - Hatchback
  - Engine Type
    - Gasoline
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