Network Manager
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EUROCONTROL

Aerospace Performance Factors - APF

25th-27th of April

ES2-WS1-2017 – NM Safety Management Tools

Bucharest – ROMATSA HQ

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Outline

- Brief intro on what is APF
- The Journey – Managing what you can measure
- Capabilities of v 2.x
- Demo
- Q & A

The Challenge & Solution

A look at the "Classic" data presentation

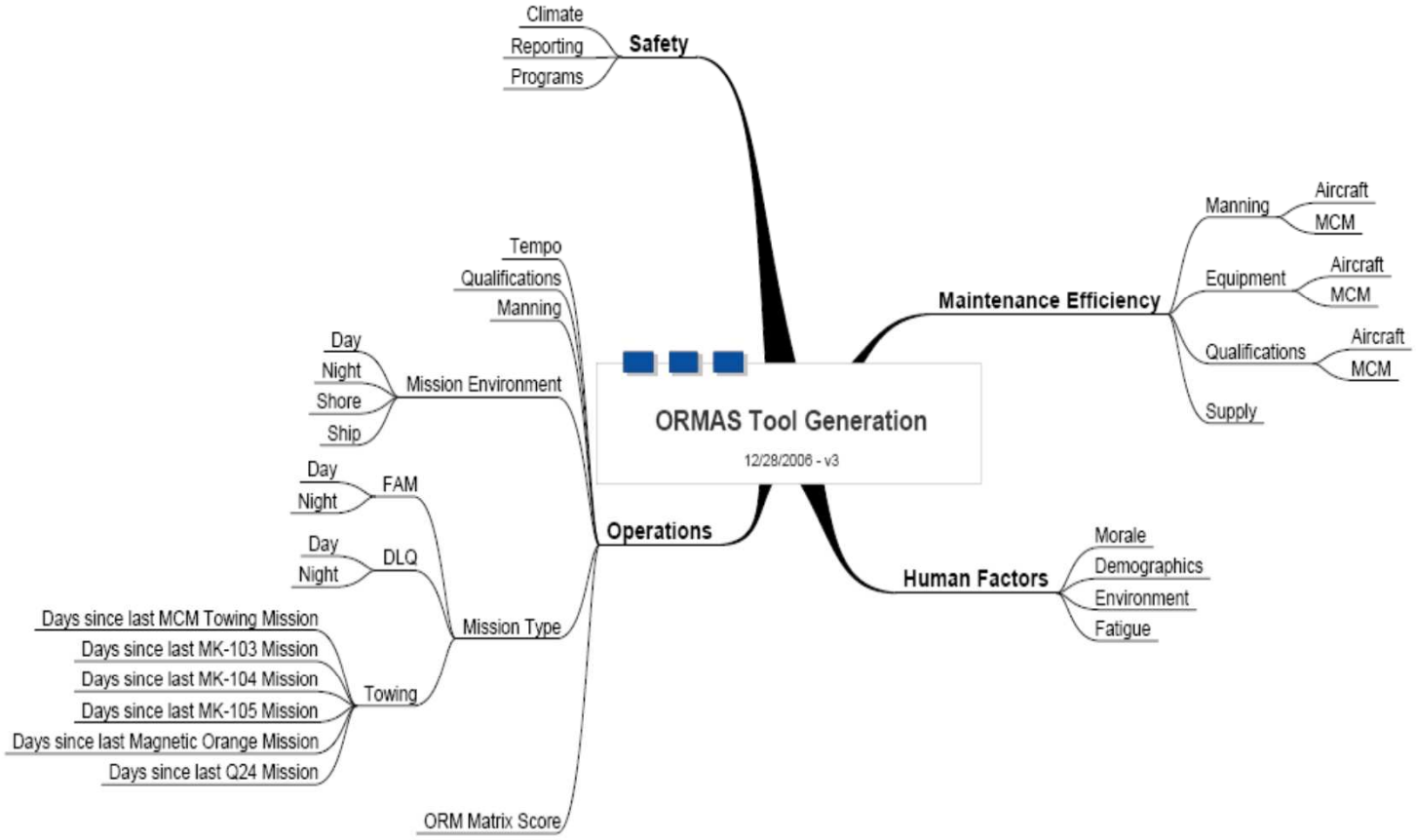
		2000		2004		Difference
Aircraft Accidents						
	Air Carrier	56		29		-27
	Air Taxi/Commuter	92		73		-19
	GA	1835		1614		-221
NMAC						-92
PDs						709
OE		1139		1216		77
VPD		547		263		-284
Surface Incidents		1396		882		-514
Runway incursions		426		310		-116
Aircraft Operations						
		46,056,000		46,762,000		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
Aircraft Hours		318,000,000		273,000,000		-45,000,000

Traditional reporting : Where's the Story ?

Hitch-hiker's guide to the… APF

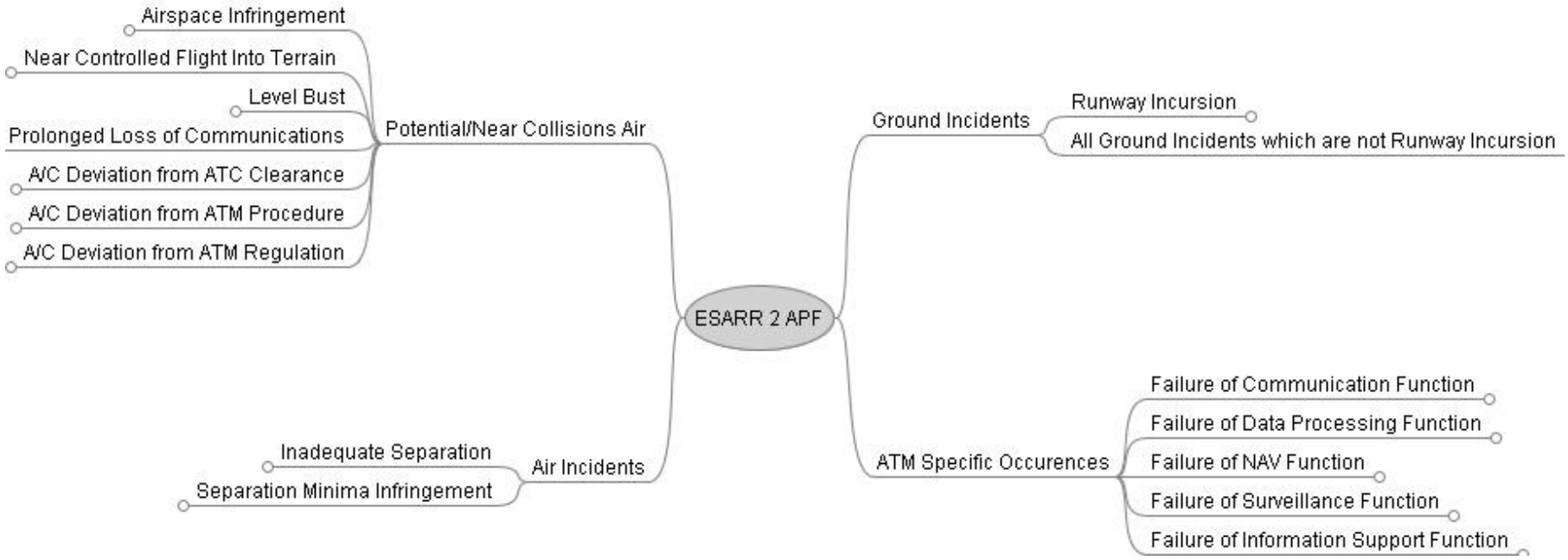
- Determine the goal. What are we measuring?
  - This is the foundation of the APF;
- Determine what data we will use
  - This is the “Clean Sheet of Paper Exercise”;
- Construct a mindmap
  - This is the critical part;
- Develop the weighting factors
  - This is the science part;
- Put it all together
  - This is the breakthrough;
- Enjoy the journey!

Example - First US Navy Mindmap: Quite Complex

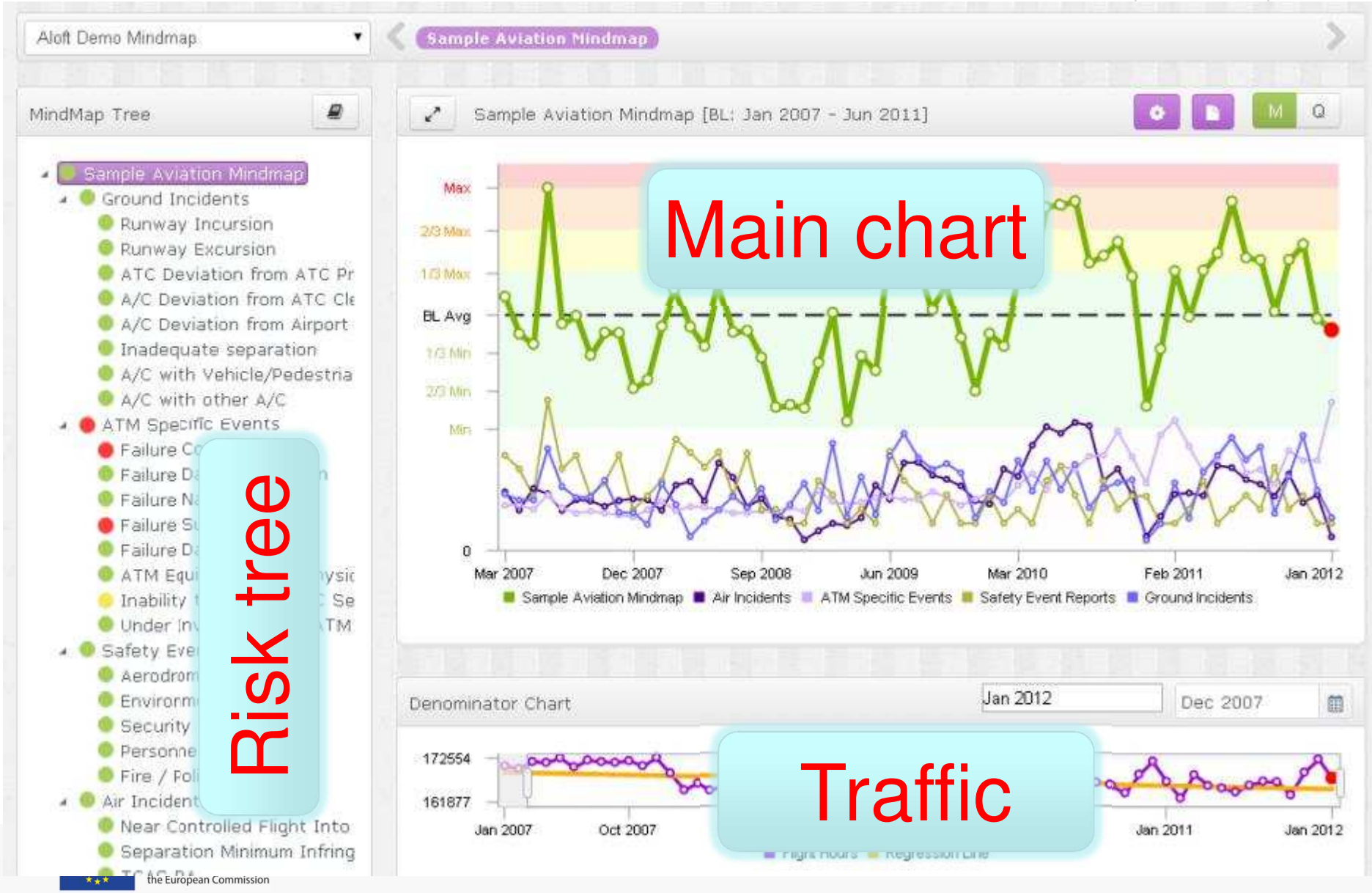


C:\Documents and Settings\AOV300SS\My Documents\ORMAS Tool Generation.mmp - 12/28/2006 - -

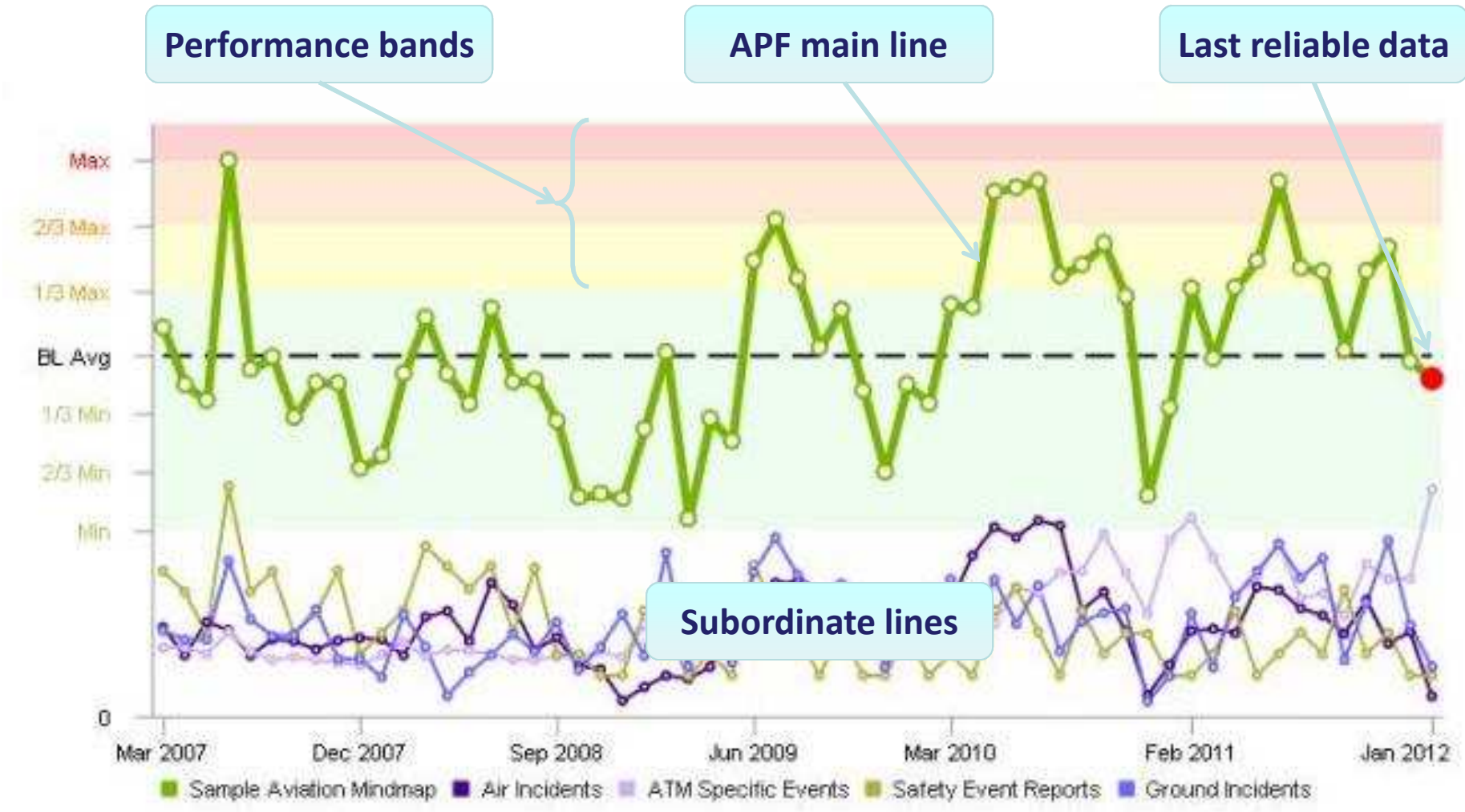
Example -EUROCONTROL Mindmap



EUROCONTROL APF



Main chart


Performance bands
APF main line
Last reliable data
Subordinate lines
Max
2/3 Max
1/3 Max
BL Avg
1/3 Min
2/3 Min
Min
0
Mar 2007
Dec 2007
Sep 2008
Jun 2009
Mar 2010
Feb 2011
Jan 2012
Sample Aviation Mindmap
Air Incidents
ATM Specific Events
Safety Event Reports
Ground Incidents

Risk tree

Selected mindmap (multiple possible)

Full mindmap (collapsible)

Colour-coded radio buttons (see performance bands on main graph)

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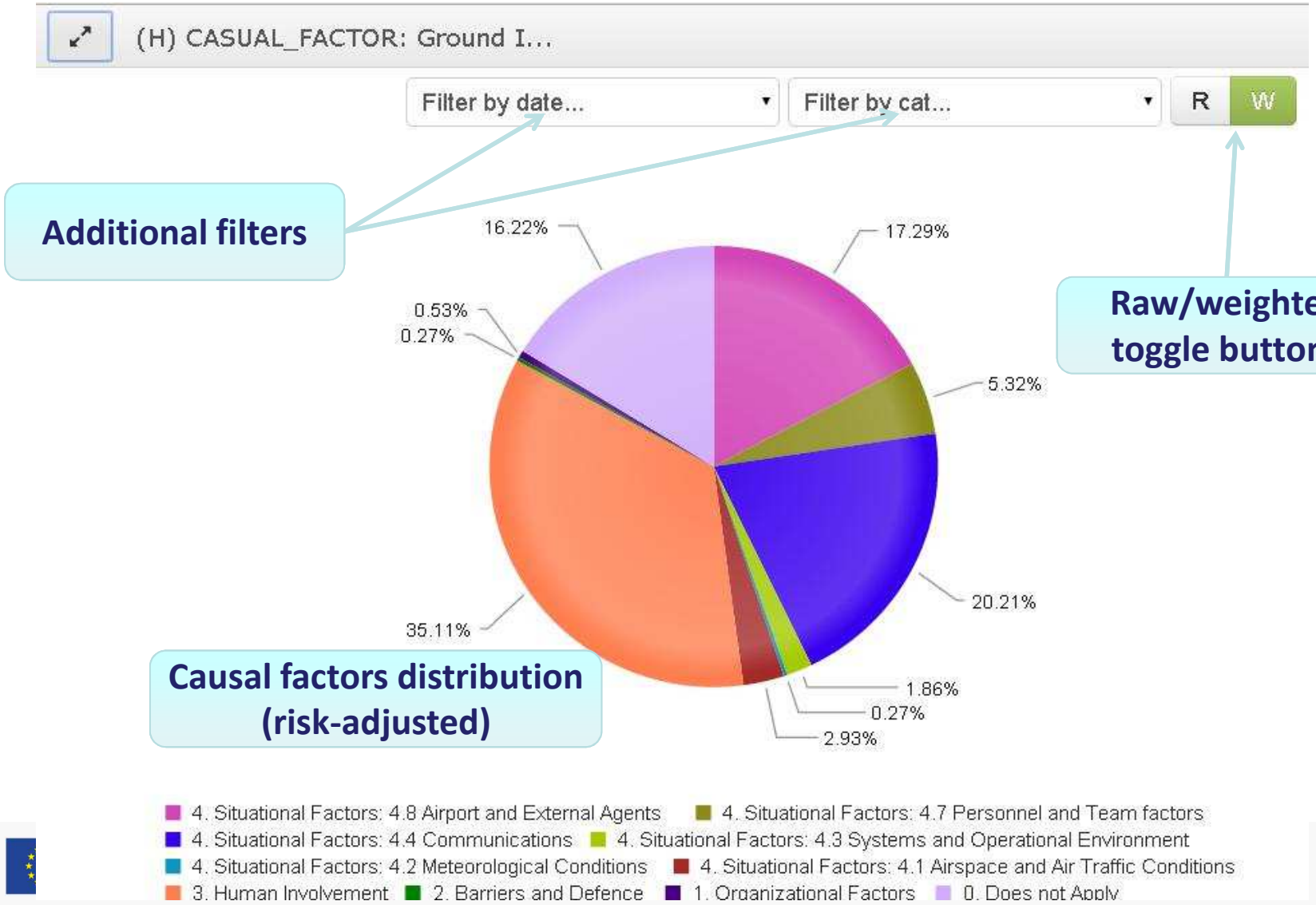
Denominator (output)

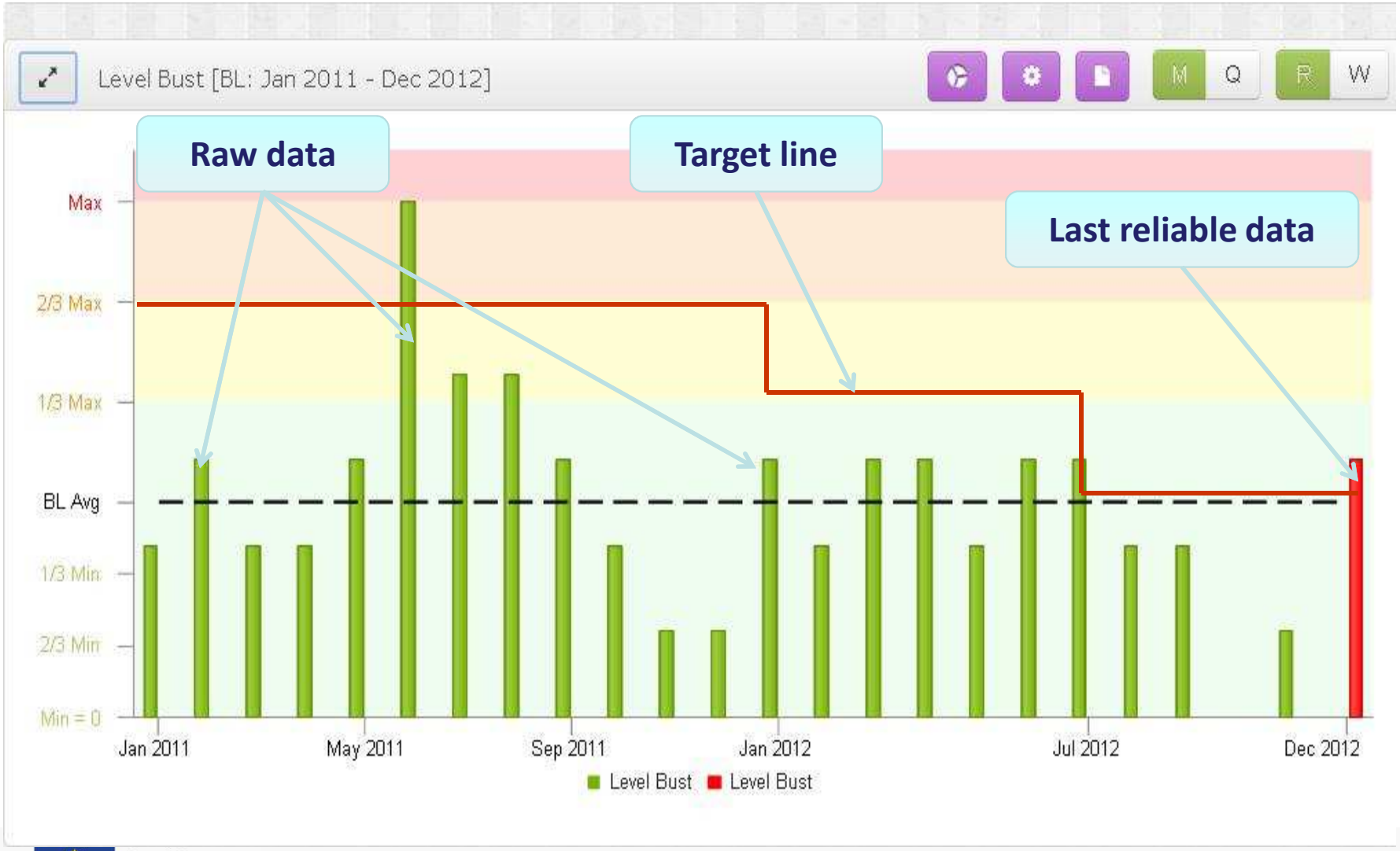
Date range selection windows

Date range selection slider

From trending to diagnostics: showing risk-weighted data

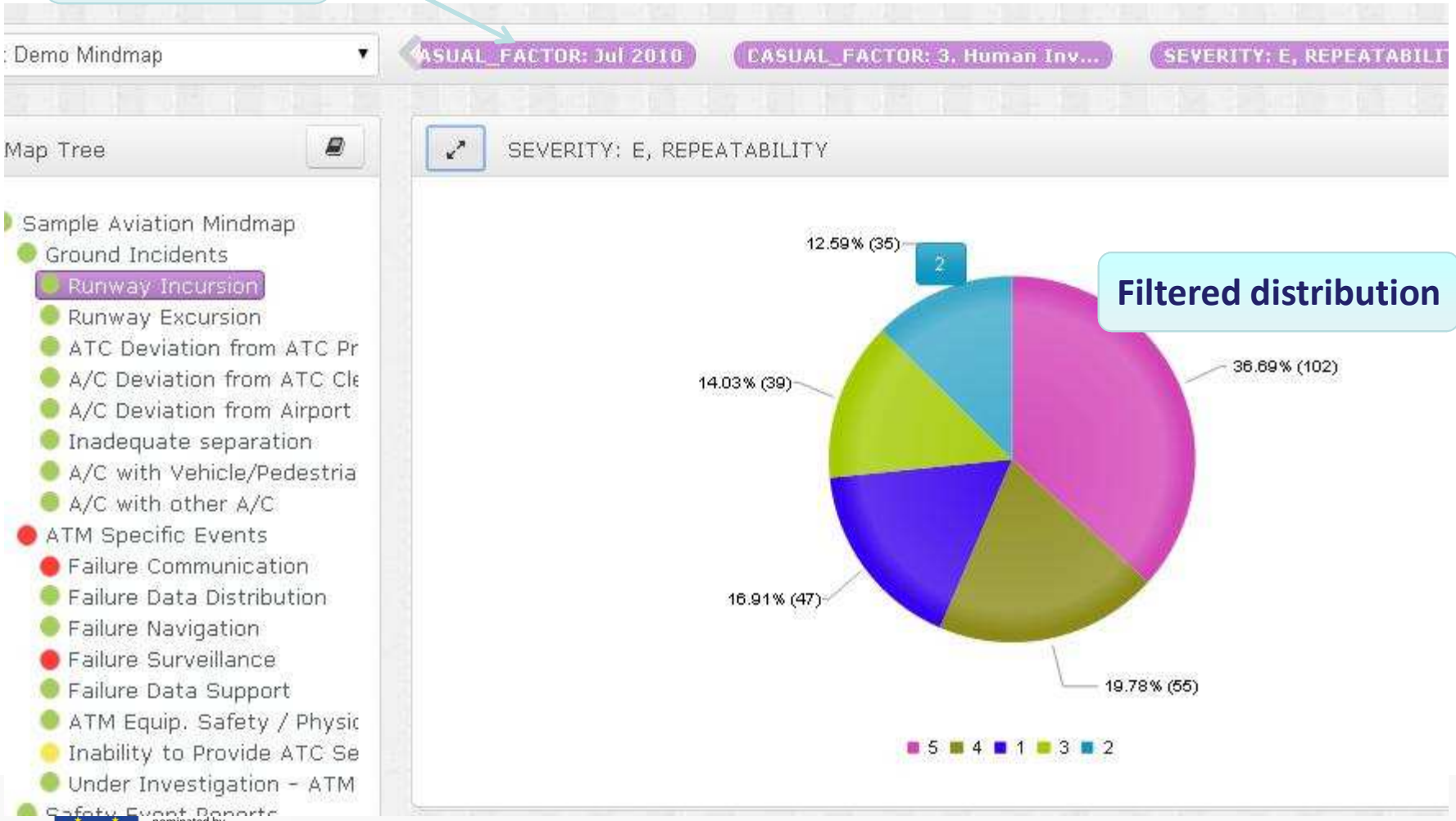


Raw data graph with target line



Drill-down diagnostic

Filter sequence (dynamic)



Filtered distribution

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APF capabilities

- Since ver v1.1:
  - Multiple users can connect concurrently;
  - Multiple mindmaps can be loaded in parallel;
  - Dynamic configuration, only data-dependent;
  - The richer the data, more filters and analyses possible;
  - Same user-management system with other ECTRL tools (eTOKAI, ASMT).
- Since v2.x:
  - A “What If” function to allow you to model data elements and time to see what the impact would be on overall performance
  - Identification of unusual trends;
  - Inclusion of positive and negative factors and hence accounting for Leading and lagging indicators;
  - Correlation Analysis to indicate relationships between data elements;
  - Pareto charts – and the ability to export them
  - Management Accounting
  - Connectivity with eTOKAI

APF capabilities

1	System thinking (safety-II)	Shifting from “what went wrong?” to “what went right?” to complement the “negative” safety analysis with positive aspects
2	Trending contributing/mitigating factors	Showing the evolution over time of the causal factors (resilience factors); (in RAT causal factors are called contributing factors and resilience factors are called mitigating factors)
3	Leading indicators, KPIs / KPAs	Shifting from an analysis based exclusively on lagging indicators into one based on leading indicators as well; Key Performance Indicators and Key Performance Areas representation
4	Management accounting	Including costs and other data in order to add managerial functions; developing the APF into a decision making tool
5	Correlation analysis	Identifying or validating cause-effect relationships between various sets of data
6	Pareto analysis	Finding those 20% causes which produce 80% of the effects

APF capabilities cont'd

7	Multiple counting	Addressing the issue of incidents with multiple contributing / mitigating factors
8	Forecasting, what-if tool	Calculating future APF index values based on different scenarios in order to assess the impact on safety of certain managerial actions
9	Mind map aggregation	Merging a number of mind maps at a lower hierarchical level to automatically produce a mind map for a higher hierarchical level (such as divisions to ANSP, or ANSPs to FAB)
10	Noise reduction	Applying methods to reduce the noise in data, which affects the accuracy of the results
11	APF consistency, comparability, scaling and linearity	Quantifying similar performance situations into similar APF values; Horizontal comparability (between organisations or units); Time comparability; Addressing the scaling issues of the APF tool; Considering a non-linear scale;

APF capabilities cont'd

12	APF time unit	Considering changing months to weeks as the APF time unit and as a base for the moving average filtering
13	Value of information and sensitivity analysis	Assessing the value of information of the APF index; Including a sensitivity analysis
14	APF semantics paradox	APF semantics is the study of how to correctly interpret the results; the paradox refers to the perception of a worsening of safety performance in case of better reporting
15	Database maturity and quality	Addressing the database maturity and quality assurance problems; Deflating the APF index with a number which quantifies the quality of reporting.
16	Cost of safety	Applying a concept where risks are calculated in terms of costs and may be traded off against costs.
17	Complexity indicators replacing activity indicators	Shifting from activity indicators to complexity indicators as a weighted average denominator to deflate the number of incidents in the index.

Example of leading indicators and Enhanced Data in APF

	Leading Indicators	Measuring unit
1	Safety culture survey	Index
2	Just culture (JC)	Index
3	Action plans	Index
4	Safety maturity	Index
5	RAT usage	% or score
6	Internal and external audits	Index, score
7	User definable	User definable

	Enhanced Data	Measuring unit
1	Special weather	Hrs/Month
2	Degraded modes	Hrs/Month
3	Work in progress on airports / ATC centres	Hrs/Month
4	Cost cuts	%/Month
5	Changes in volume of traffic	±%/Month
6	Staffing changes	±%/Month
7	Operational changes	%/Month
8	New systems being implemented (how much of the total system has been changed)	%/Month
9	Special events	Hrs/Month
10	User definable	User definable

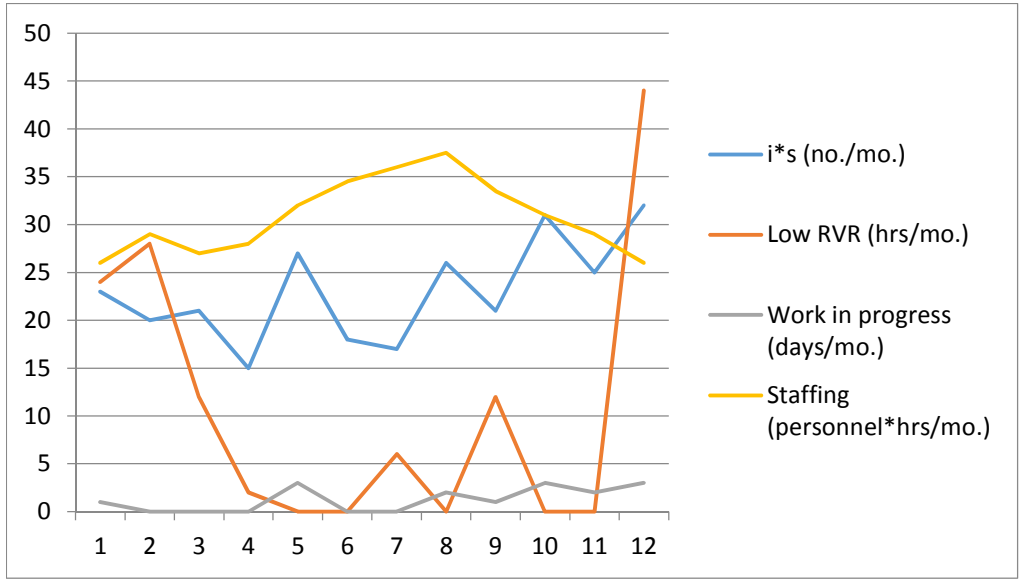
Management accounting (examples)

- Management accounting is “the provision of financial and non-financial decision-making information to managers”.

	Management accounting data	Measuring unit
1	ATCO Staff Workload	Personnel*Hrs/Month
2	Average ATCO Staffing	Employees/Month
3	Average capacity usage	%/Month
4	Number of flights	Flights/Month
5	Number of flight hours	Hrs/Month
6	Operational costs	€‘000/Month
7	Operational revenues	€’000/Month
8	Budgeted investments in safety	€’000/Month
9	ATC delays	Mins/Month
10	User definable	User definable

Correlation analysis (examples)

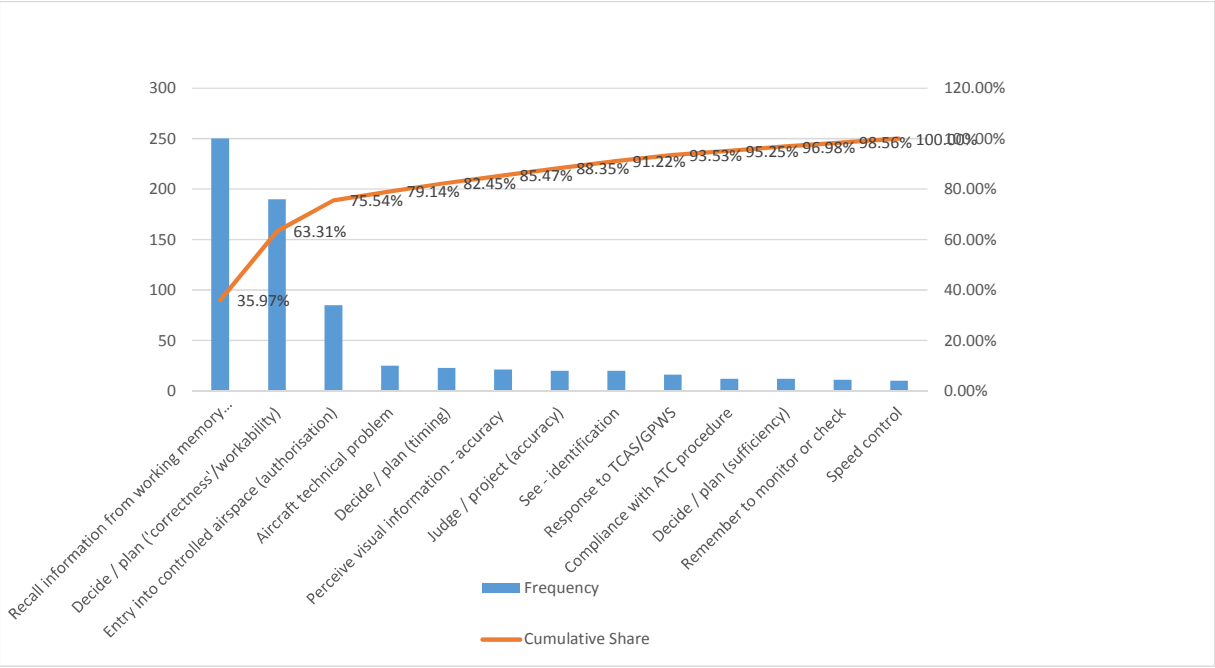
- Correlation analysis is a method that enables the identification of a variation link between more sets of time series



	i*s	Low RVR	Work in Progress	Staffing
i*s (no/mo.)	1			
Low RVR (hrs/mo.)	0.250937894	1		
Work in Progress (days/mo.)	0.934939208	0.03940329	1	
Staffing (personnel*hrs/mo.)	-0.172973209	-0.587680884	-0.042736069	1

Pareto analysis (examples)

- A Pareto analysis is a method developed to detect the contributing factors, which generate most of the incidents. It relies on the non-linearity of causal phenomena. Non-linearity may be explained by the 80/20 law: there is a probability that 80% of the effects are caused by only 20% of the causal factors. In reality, these percentages may differ

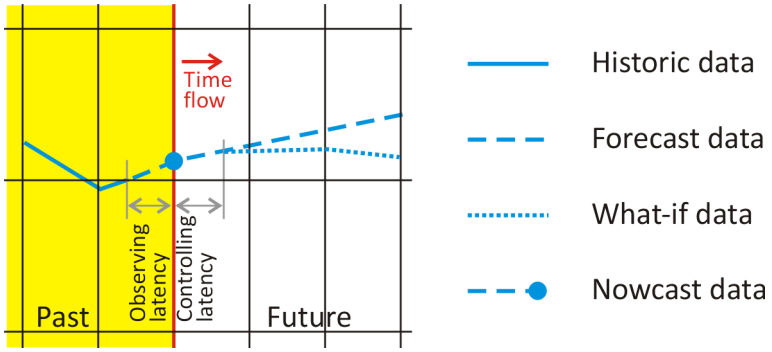


“Forecasting”, What-if tool

Decision making is made possible thanks to the following elements:

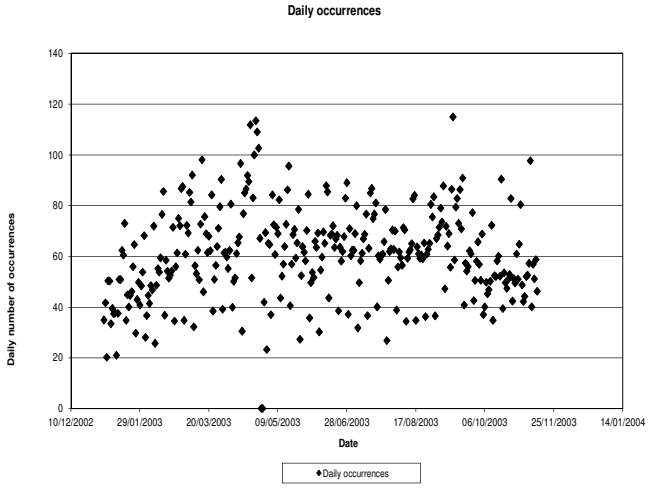
- Observability: the use of consistent and comparable metrics to measure all relevant states of systems required to be managed. The state vector (system’s output) is measured at defined present times, thus allowing record of past states.
- Controllability: the use of methods or levers to effectively control the system, by applying a control vector (system’s input). The controlling methods eventually show their effects in the future, after a certain delay (system’s latency).
- Forecasting: a method to predict the future evolutions of the system, or the response of the system to internal and external stimuli.

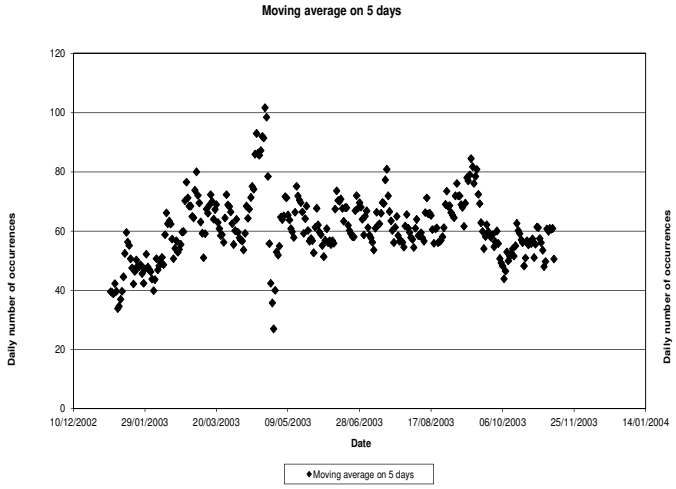
In absence of any one of these three pillars, the system is not manageable.
Forecasting is particularly relevant in the framework of managerial functions: forecast and plan, organize, command, coordinate, and control

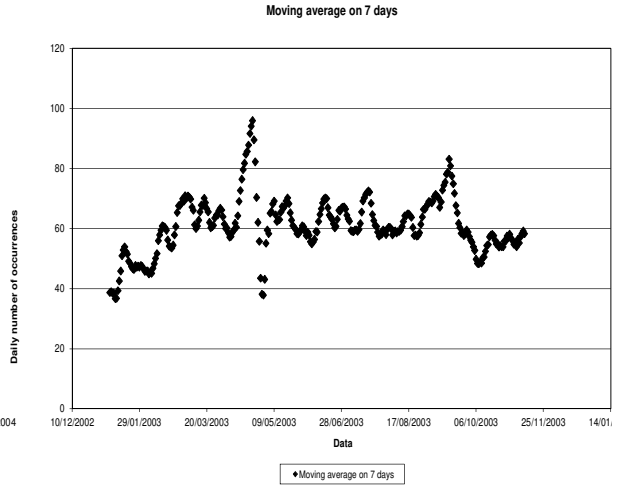


Noise reduction

- Safety data are subjected to “noise” (variations in the output results due to random irrelevant factors).
- Random irrelevant factors often play a role in incidents and accidents.
- The number of incidents * severity is a random variable and is naturally affected by data noise.
- Noise masks the useful and relevant information
- APF 2.0 considers the use of a noise filter for the data. This can be achieved by applying a moving average to filter out some irrelevant inputs.







In summary and Depending On Your Data

Supports Positive Safety	Supports Leading Indicators, KPAs / KPIs
Management accounting of costs	Correlation Analysis
Pareto Analysis	Multiple Counting
Modeling and (basic) forecasting via the What If Tool	Data noise reduction
Changeable time units	Adjusts for data semantics paradox (higher numbers can be good, etc.)
Warning when limited data makes results statistically questionable	

Conclusions

- The APF is not a stand alone tool and current measurements must be maintained.
- The APF identifies “what” is happening, “where”, and “when” through both trending and diagnostics:
  - This allows for focus of resources to identify problem area.
  - As additional metrics, with greater granularity, are introduced into the APF (e.g through eTOKAI), it will enable the quest for “why.”
- It’s a beginning in Data Visualisation & Discovery: The rise of Data Storytelling
- **The key word: prioritisation! The APF is best at pointing out where things happen and also where to get the biggest bang for the buck.**

Thank you for your attention !

Demo and Questions