

From SESAR to Implementation: Completing the TBS Picture

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Wakenet-Europe Workshop 2014



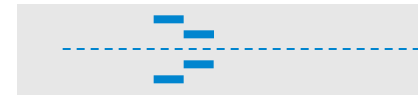
Time Based Separation

- Separate arriving aircraft by time instead of distance
- Reduction in separation in medium/strong headwind
 - *turbulent decay in-ground/near-ground*
- Increase in separation in still/light winds
- Improved *management* of wake turbulence risk

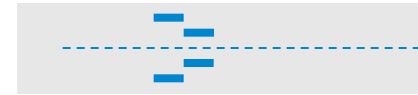
Nautical Miles	3	4	5	6	7	8
TBS equivalent (seconds)	68	90	113	135	158	180

TBS Landing Rate Recovery

Normal Landing Rate – Light Headwind



Reduced Landing Rate – Strong Headwind



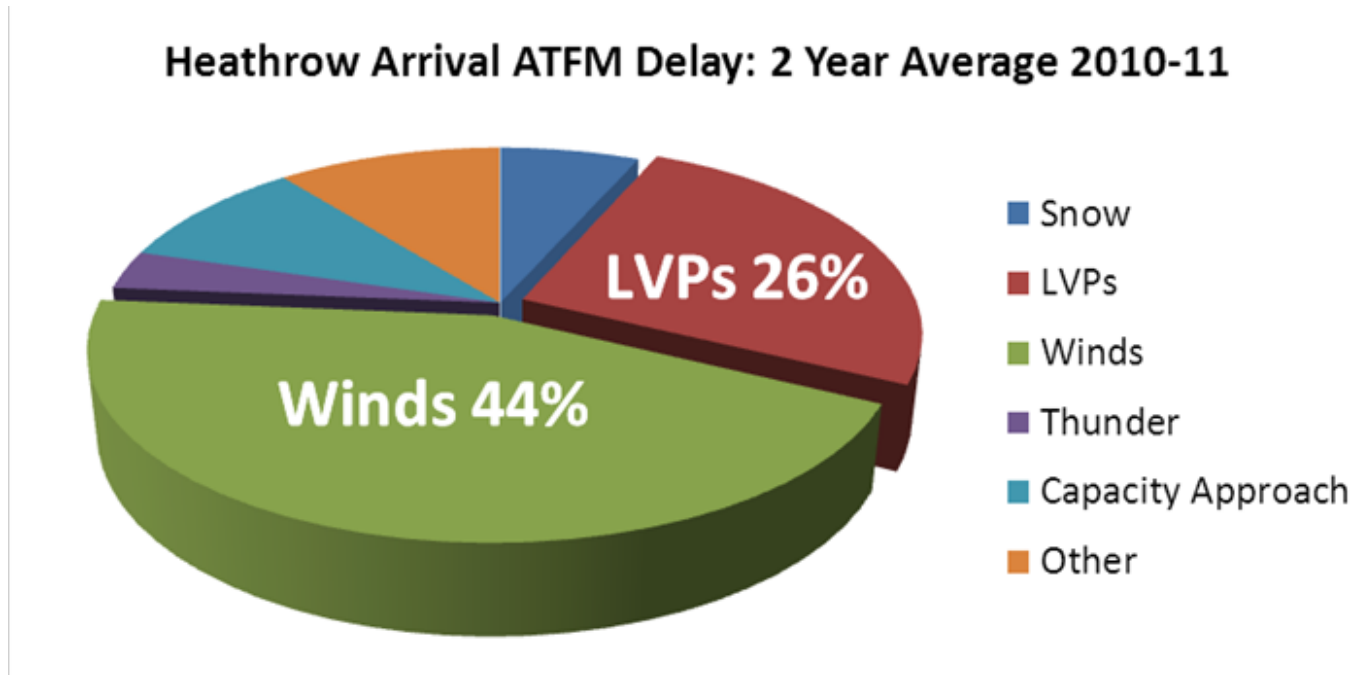
TBS Landing Rate – Strong Headwind



Heathrow Headwind Delay

Headwinds cause c.40% of Heathrow arrival ATFM delays

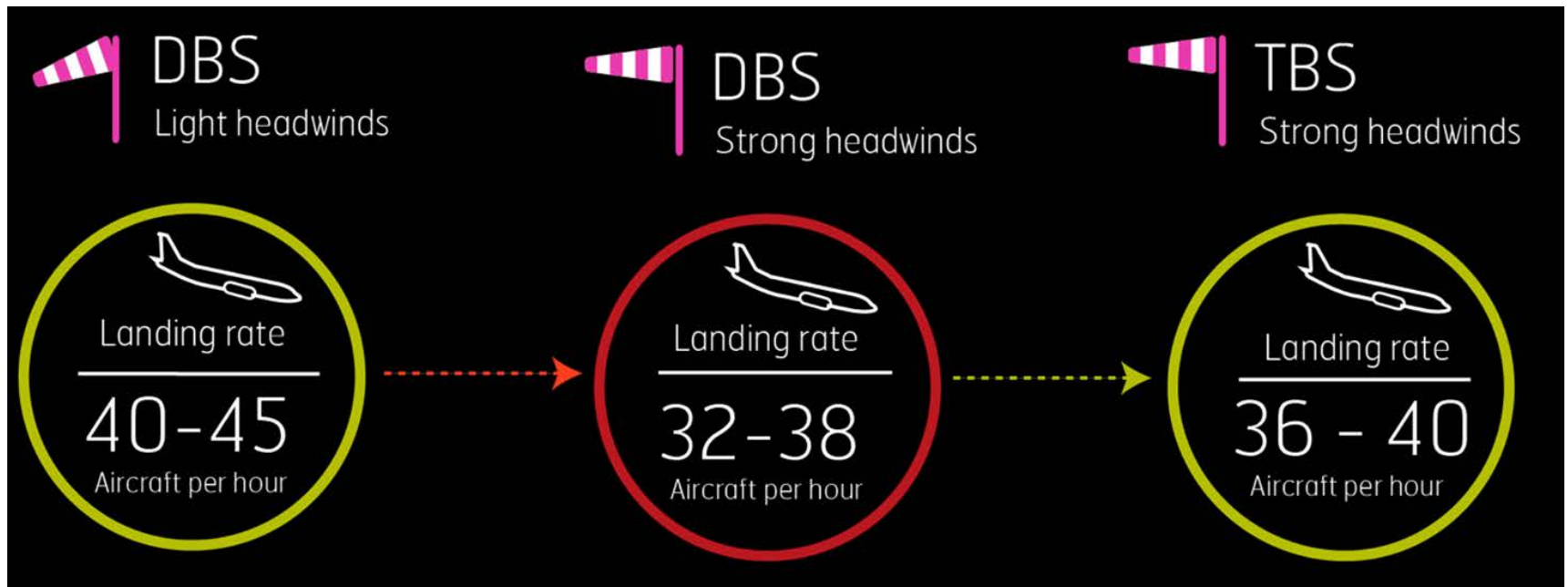
Heathrow Delays by Cause:



Local TBS Deployment

- Applied with NATS 6 category system
- Initial deployment for Heathrow
- Keeping it simple :

minimum change from current operations to realise benefit



From SESAR

Generic proof
of concept

LIDAR
data
collection

Early concept validation
(E-OCVM V3)

TBS



... to TBS Implementation

Generic proof
of concept

LIDAR
data
collection

Advanced forecast
using Mode-S

Early concept validation
(E-OCVM V3)

TBS

Safety Case

Training and
Transition

99.97%
accurate

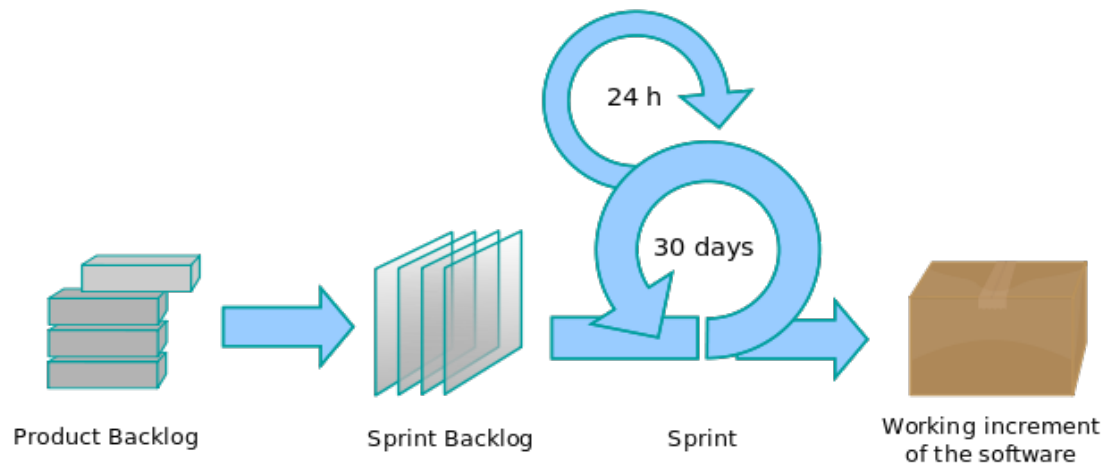
Industrialised
Solution

wind effect forecast

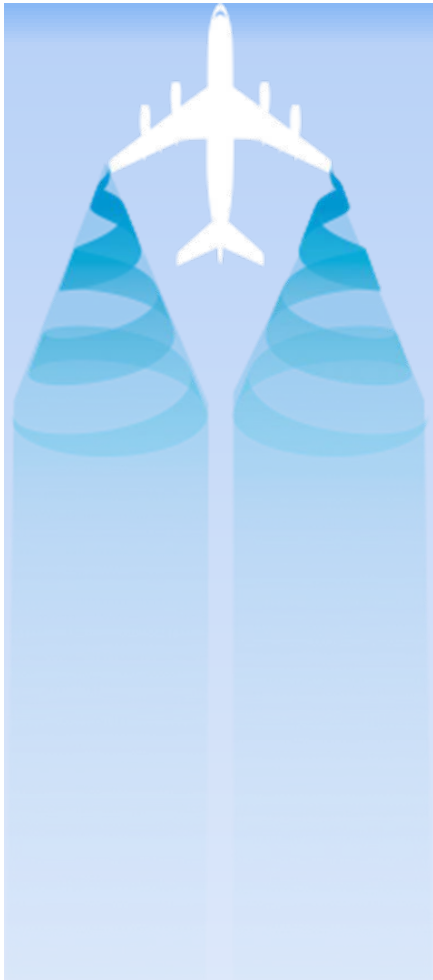


Agile Development

- › Focused incremental delivery of a working system
- › Prioritised development
- › Integrated user involvement
- › Concept refinement & Working system increments
- › *Resolving the challenge of traditional sequential process*



TBS Implementation



What's to do?

- Concept Development
- Define a Validated Met capability
- Engineering & Development
- Safety Assurance
- Tool Implementation, verification
- Training & transition
- Safety Case
- Supporting safety evidence
- Regulatory Approval
- Operational monitoring

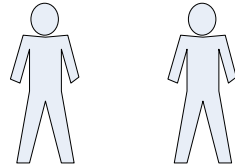
Technical* challenges:

* Other Challenges exist!!!

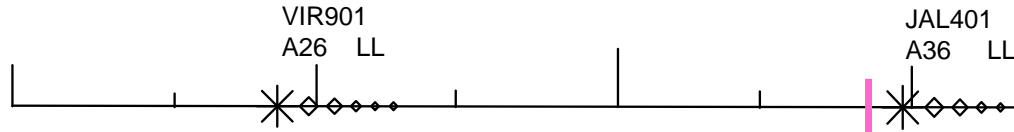
- AMAN Sequence not sufficient
- No mature Met capability from SESAR
- Safety Assurance

Project Mantra: *Keep it Simple !!*

TBS Tool Overview



LL Tower LL Approach

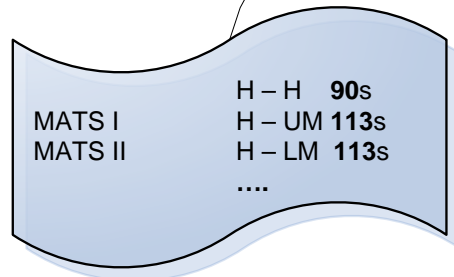
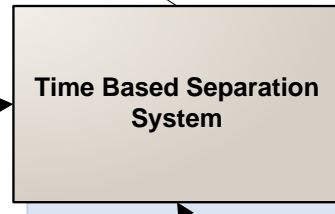


Separation Indicators for Final Approach and Tower

	3	4	TBS Distance 5	6	7	8
DBS	3	4	5	6	7	8
TBS	3.0	3.8	4.6	5.4	6.1	6.9

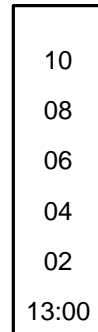


Wind Conditions



Rules Change

- 4 BAW284 LM BIG 13:09
- 3 SHT3N LM BNN 13:07
- 2 JAL401 HH LAM 13:05
- 1 VIR901 HH LAM 13:04



Final Approach Sequence Order

UAE1
070 LL 070
G255 I220
♦♦♦♦

BAW12
064 LL 50
G253 I220
♦♦♦♦

NIC
A40 LL 40
G177 I180
♦♦♦♦

BAW895
A37 LL
G176 I180

SHT9N
A27 LL
G154 I160

BMA3RF
A17 LL
G154 I160

BAW154 BAW663
A02 LL A01 LL 40
G133 I160 G101 I160

BAW085
A05 D 60
G187 I192
♦♦♦♦

IBE3174
A44 LL 40
G193 I184
♦♦♦♦

TAP378
079 LL 070
G259 I220
♦♦♦♦

BAW005
A50 LL 40
G247 I220
♦♦♦♦

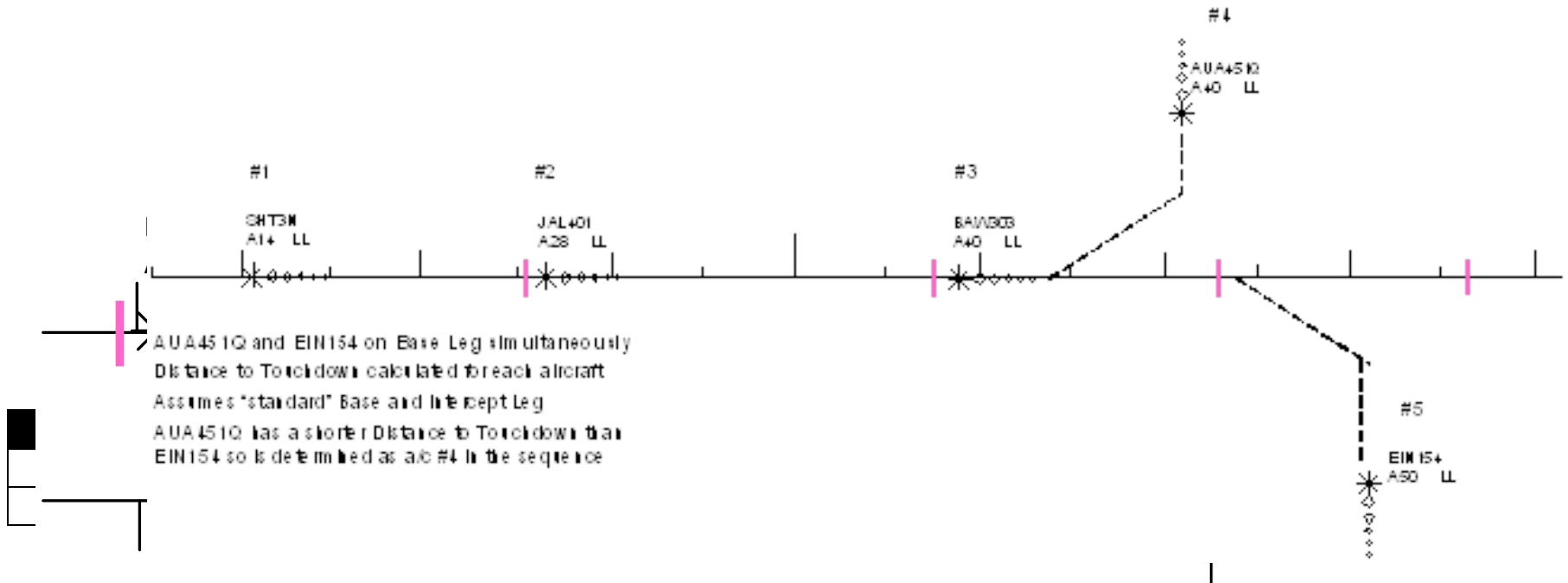
Concept Development

Adaptive Auto-Sequence

Wake Only Indicators

Spacing

FLT001 & FLT002



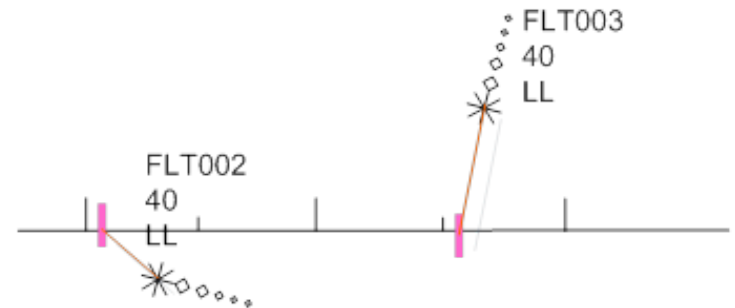
Quick Look Tools

Distance indicators

- > TBS indicator distance
- > Actual distance from indicator



Aircraft/indicator pairing



TBS Met.

TBS Separation minima defined by headwind impact on Ground Speed

Groundspeed impact over the separation distance to 4DME is forecast

- *Glideslope Wind Condition Service (GWCS)*
- *Consistent time separation delivered at 4DME*

Mode-S DAPS used to provide Met observations

- *Subject to quality checking & smoothing*
- *Simple system was more effective than complex solution (e.g. incorporating forecast models)*
- *Validation over 1 year data set*

Interim Performance : >10Kts over-estimate 0.03%

- *equivalent HH (4NM) distance effect of 10 Kts ~ 0.25NM*
- *Errors predominantly in strong wind conditions (low WTE risk)*

Algorithm has been refined & performance characterised:

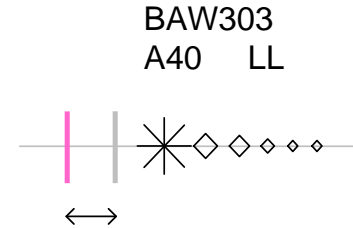
- *Over-estimates of Wind used in safety assurance*

Impact of Met Uncertainty



Indicator (assured) presented to controller. Based on forecast wind conditions.

Indicator position if wind conditions known precisely(*).



Impact of difference between forecast and actual wind conditions

- Indicator position assured knowing that precise wind conditions will not be known in advance
- Define uncertainty due to Met in this way
- Under normal operating conditions (excluding failure)

Safety Evidence

Safety Argument : “No Degradation in Safety”

- › Relative Approach using ‘Reasonable Worst Case’
- › Normal, Abnormal & failure cases
- › All regions of approach for applicable TBS Separation

Wake only indicators => wake only WTE safety evidence

Safety Evidence:

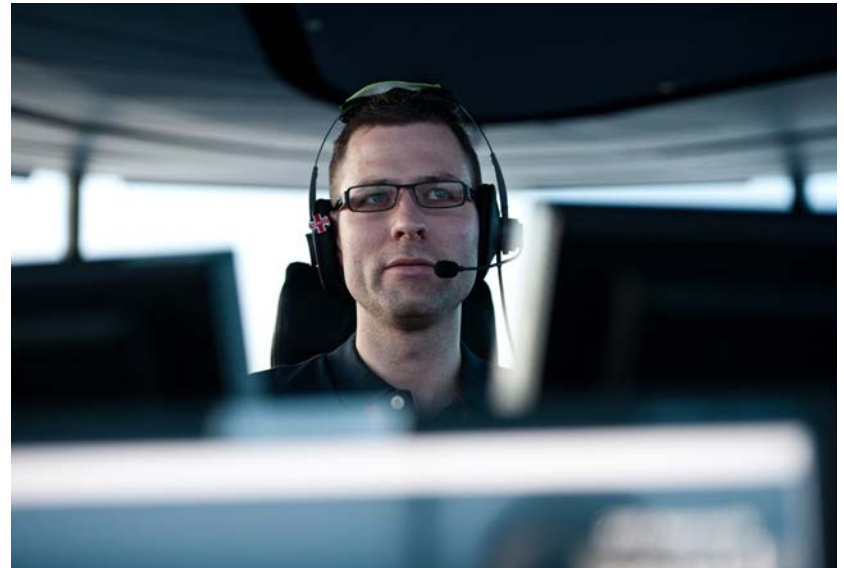
- › Lidar IGE/NGE & OGE
- › Wake modelling support to safety arguments (eg glide and intercept)
- › Reported Wake Encounter (including extrapolation)
- › Sensitivity analysis relating to GWCS performance
- › Estimated Impact on Reported Wake Encounter

HazId / HESAP:

- › Controller skill retention with wake only
- › Indicator not presented when on downwind improves WTC check

Project Status

- Iterative Development phase
 - Significant progress in tool development
 - Operational Engineering in progress
 - Project Safety Assessment Report being prepared
 - Safety Evidence being produced
-
- Operational Deployment in Spring 2015



Video



Questions ?

