EUROCONTROL Wake Program

WakeNet Europe 2015
EUROCONTROL Runway Throughput Enhancement Program

WakeNet Europe 2015

Vincent TREVE
20-04-215
Outline

- Introduction
- Runway throughput enhancement solutions
- Integration and Leading Optimised Delivery Tool
- Conclusion
Introduction

Analysing summer period 2012, 6 airports were “congested” in the sense of operating at 80% or more of their capacity for more than 3 hours per days.

This is expected to grow to 30 airport in 2035…

… however through bilateral discussions with airports, it appears that today many more airports have constrained peak hours (<3h) during which runway capacity is either a source of delay OR a limitation to business development.
Aircraft separations today

For congested runway (during peak hours), separations are primarily imposed by ICAO wake turbulence separations...

<table>
<thead>
<tr>
<th>MTOM ≤ 7T</th>
<th>7T &lt; MTOM &lt; 136T</th>
<th>MTOM ≤ 136T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>Medium</td>
<td>Heavy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preceding aircraft</th>
<th>Succeeding aircraft</th>
<th>Wake turbulence radar separation minima</th>
</tr>
</thead>
<tbody>
<tr>
<td>A380-800</td>
<td>A380-800</td>
<td>Not required*</td>
</tr>
<tr>
<td>A380-800 non-A380-800 HEAVY</td>
<td>Non-A380-800 HEAVY</td>
<td>11.1 km (6.0 NM)</td>
</tr>
<tr>
<td>A380-800</td>
<td>MEDIUM</td>
<td>13 km (7.0 NM)</td>
</tr>
<tr>
<td>A380-800</td>
<td>LIGHT</td>
<td>14.8 km (8.0 NM)</td>
</tr>
</tbody>
</table>
Aircraft separations today

For congested runway (during peak hours), separations are usually primarily imposed by ICAO wake turbulence separations … but not only, for example:

- Complex constraints may be applied for departure clearance resulting from simultaneous arrival and departure on CSPR

Landing and take-off North Runways at LFPG
Aircraft separations today

For congested runway (during peak hours), separations are usually primarily imposed by ICAO wake turbulence separations … but not only, for example:

- A gap may need to be created in an approach sequence during mix-mode operations
Aircraft separations today

For congested runway (during peak hours), separations are usually primarily imposed by ICAO wake turbulence separations … but not only, for example:

- A gap may need to be created in an approach sequence during mix-mode operations

Mix-mode in LOWW
Aircraft separations today

Today, these separations are applied without a controller support tool.
Tomorrow separations will be resulting from very different solutions

- CSPR Operations
- Mixed Mode Ops
- ICAO Separations
Tomorrow separations will be resulting from very different solutions
Separation based on a more efficient 6 wake category scheme (European Wake Re-categorisation - RECAT-EU)

RECAT-EU is a regulated standard developed by EUROCONTROL that increases runway capacity by 3 to 8% (in peak) and better protects small aircraft with limited system upgrade.

200,000+ wake measurements (LiDAR)

100+ hours flight test (wake encounters)

Watch video = https://www.youtube.com/watch?v=cqpZ_xkr-Pw
Separation based on a more efficient 6 wake category scheme (European Wake Re-categorisation - RECAT-EU)

RECAT-EU is a regulated standard developed by EUROCONTROL that increases runway capacity by 3 to 8% (in peak) and better protection of small aircraft with limited system upgrade.

Watch video = https://www.youtube.com/watch?v=cqpZ_xkr-Pw
Tomorrow separations will be resulting from very different solutions

- CSPR Operations
- Mixed Mode Ops
- RECAT-EU
Tomorrow separations will be resulting from very different solutions.
Separation based on time in place of distance (Time Based Separation - TBS)

Time Based Separation (TBS) permits the adaptation of separations to maintain runway throughput in strong headwind conditions.
Separation based on time in place of distance (Time Based Separation - TBS)

Time Based Separation (TBS) permits the adaptation of separations to maintain runway throughput in strong headwind conditions

- Strong headwind increases time separation for constant distance applied

![Diagram showing the difference between low and strong headwind separations with time-based calculations.](image-url)
Separation based on time in place of distance (Time Based Separation - TBS)

Time Based Separation (TBS) permits the adaptation of separations to maintain runway throughput in strong headwind conditions

- Strong headwind increases time separation for constant distance applied
- Reduced separations support constant time between 2 landings in strong headwind conditions
Tomorrow separations will be resulting from very different solutions.

- CSPR Operations
- Mixed Mode Ops
- RECAT-EU
- Time Based Separation
- SESAR-1

Existing solution
Tomorrow separations will be resulting from very different solutions.
Separation defined per pair of aircraft types (Pairwise separations - PWS)

Separations are adapted as a function of leader and follower aircraft type characteristics (RECAT-2)
Separations defined per pair of aircraft types (Pairwise separations - PWS)

Separations are adapted as a function of leader and follower aircraft type characteristics (RECAT-2)

Separations are designed for the top 100 most frequent aircraft as a function of leader and follower characteristics (RECAT-2)
Separation defined per pair of aircraft types (Pairwise separations - PWS)

Separations are adapted as a function of leader and follower aircraft type characteristics (RECAT-2)

RECAT-2 – Pair Wise Separations currently under consultation

A320

ICAO 5.0 Nm

A343
Separation defined per pair of aircraft types
(Pairwise separations - PWS)

Separations are adapted as a function of leader and follower aircraft type characteristics (RECAT-2)

RECAT-2 – Pair Wise Separations currently under consultation

<table>
<thead>
<tr>
<th>Leader Aircraft</th>
<th>1.5</th>
<th>2.5</th>
<th>3.5</th>
<th>4.5</th>
<th>5.5</th>
<th>6.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>B738</td>
<td>2.5</td>
<td>3</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>4.5</td>
</tr>
<tr>
<td>B738</td>
<td>2.5</td>
<td>3</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>4.5</td>
</tr>
<tr>
<td>A320</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A320</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>B788</td>
<td>2.5</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td>B788</td>
<td>2.5</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td>A332</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A332</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A343</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A343</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A342</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A342</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>B772</td>
<td>2.5</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td>B772</td>
<td>2.5</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td>A333</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A333</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A342</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A342</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>B788</td>
<td>2.5</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td>B788</td>
<td>2.5</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td>A332</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A332</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A343</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A343</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A342</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>A342</td>
<td>3.5</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>6</td>
<td>6.5</td>
</tr>
</tbody>
</table>

**Separation explained**

- **Separation defined per pair of aircraft types**
- **Pairwise separations - PWS**
- **Separations are adapted as a function of leader and follower aircraft type characteristics (RECAT-2)**

**Legend**

- **A320**
- **A343**
- **ICAO 5.0 Nm**
Separation defined per pair of aircraft types (Pairwise separations - PWS)

Separations are adapted as a function of leader and follower aircraft type characteristics (RECAT-2)

| Aircraft Type | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| A343          | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| A353          | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| A342          | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| B788          | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| G5111         | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   |
| 8764          | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 8762          | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 8763          | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| A306          | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| A308          | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| A310          | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 8752          | 1.5 | 1.5 | 2   | 2   | 1.5 | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   |
| 8753          | 1.5 | 1.5 | 2   | 2   | 1.5 | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   | 2   |
Tomorrow separations will be resulting from very different solutions.

- CSPR Operations
- Mixed Mode Ops
- RECAT-EU
- Time Based Separation
- Pairwise Separation

Existing solution

| SESAR-1 | Time Based Separation | Pairwise Separation |
Tomorrow separations will be resulting from very different solutions.

Existing solution

CSPR Operations

Mixed Mode Ops

RECAT-EU

Time Based Separation

Pairwise Separation

Weather Dependant Separation

SESAR-1
Separation defined as a function of weather conditions (Weather Dependent Separations - WDS)

Separations are adapted as a function of weather conditions (Wind)

Results from data analysis of the LiDAR campaign
Separation defined as a function of weather conditions (Weather Dependent Separations - WDS)

Separations are adapted as a function of weather conditions (Wind)

Results from data analysis of the LiDAR campaign in EGGL
Separation defined as a function of weather conditions (Weather Dependent Separations - WDS)

Separations are adapted as a function of weather conditions (Wind)

Results from data analysis of the LiDAR campaign in EGGL
Separation defined as a function of weather conditions (Weather Dependent Separations - WDS)

Separations are adapted as a function of weather conditions (Wind)

Results from data analysis of the LiDAR campaign in EGGL
Separation defined as a function of weather conditions (Weather Dependent Separations - WDS)

Separations are adapted as a function of weather conditions (Wind)

Results from data analysis of the LiDAR campaign in EGGL
Separation defined as a function of weather conditions
(Weather Dependent Separations - WDS)

Separations are adapted as a function of weather conditions (Wind)

Wake separation constraints can be fully relaxed for crosswind component of more than 7kt

No wake constraints

Strong crosswind in EHAM
Tomorrow separations will be resulting from very different solutions.

Existing solution:
- CSPR Operations
- Mixed Mode Ops
- RECAT-EU

SESAR-1:
- Time Based Separation
- Pairwise Separation
- Weather Dependant Separation
Tomorrow separations will be resulting from very different solutions.
Separation based on predicted Runway Occupancy Time (ROT)

Separations are adapted as a function of Leader (predicted) Runway Occupancy Time (ROT)
Tomorrow separations will be resulting from very different solutions
Tomorrow separations will be resulting from very different solutions

CSPR Operations
Mixed Mode Ops
RECAT-EU

Existing solution

SESAR-1
Time Based Separation Pairwise Separation Weather Dependant Separation

SESAR-2020
Runway Occupancy Time

Enhanced Procedures

SESAR-1

CSPR Operations
Mixed Mode Ops
RECAT-EU

Existing solution

SESAR-1
Time Based Separation Pairwise Separation Weather Dependant Separation

SESAR-2020
Runway Occupancy Time

Enhanced Procedures
Separation reduced thanks to Enhanced Approach Procedures

Separations are adapted as a function of Leader and Follower glideslope and threshold aiming points.

HALS/DTOP Experimentation
Tomorrow separations will be resulting from very different solutions

**Existing solution**

- CSPR Operations
- Mixed Mode Ops
- RECAT-EU

**SESAR-1**

- Time Based Separation
- Pairwise Separation
- Weather Dependant Separation

**SESAR-2020**

- Enhanced Procedures
- Runway Occupancy Time

**Enhanced Procedures**
Tomorrow separations will be resulting from very different solutions

Integration of these concepts shall be transparent for the controllers ...
Tomorrow separations will be resulting from very different solutions

... and supported by an integration system called

“Leading Optimised Runway Delivery”
How does it tool works?

All solutions define optimised time separations from different perspectives.

CSPR Operations

Mixed Mode Ops

RECAT-EU

Time Based Separation

Pairwise Separation

Weather Dependant Separation

T1

T2

T3

T4

T5

T6

T7

T8

Enhanced Procedures

Runway Occupancy Time
How does it tool works?

Since all minima shall be respected, only the most constraining one is considered by the ORD Tool:

\[ \text{Time separation} = \max (\{T1,T2,\ldots,Tn\}) \]
How does it work?

The time separation

Time separation

Final Target Distance
Final Target Distance (FTD) indicator of the LORD
How does it work?

The time separation is converted into Final Target Distance.
How does it work?

Aircraft speed profile models are calibrated against extensive radar data and Mode-S data from several European airports.

Model

Data

200,000+ radar tracks analysed
How does it works?

Optimum separation delivery also requires efficient anticipation of “the compression effect” caused by aircraft speed reduction in final approach phase.
How does it work?

Optimum separation delivery also requires efficient anticipation of “the compression effect” caused by aircraft speed reduction in final approach phase.
How does it works?

Optimum separation delivery also requires efficient anticipation of “the compression effect” caused by aircraft speed reduction in final approach phase.
How does it work?

Optimum separation delivery also requires efficient anticipation of “the compression effect” caused by aircraft speed reduction in final approach phase.
How does it works?

Optimum separation delivery also requires efficient anticipation of “the compression effect” caused by aircraft speed reduction in final approach phase.
How does it work?

The LORD also provides the controller with an Initial Target Indicator (ITD). This second chevron defines the separation on the glide that will permit delivering the minimum separation at threshold.
How does it work?

Both chevrons are displayed to approach and tower controller positions.
How does it works?

The LORD needs, as input, the intended final approach sequence order for providing the approach controller with the required separations to apply.

The “a priori” sequence is the one provided by the AMAN …

… but this can be easily changed tactically by the approach controller using a specific sequencing tool on the radar screen.
Integration of Runway Throughput Enhancement Solutions

- Mixed Mode Ops
- CSPR Operations
- RECAT-EU
- Time Based Separation
- Weather Dependant Separation
- Runway Occupancy Time
- Enhanced Procedures
- LORD
- Initial & Final Target Distance
- Aircraft Speed Profile Model
- Sequencing Tool

AMAN

Speed profiles from ECTL model

Aircraft Speed Profile Model

A346
B738
A320
AT72
Integration of Runway Throughput Enhancement Solutions

Real time simulations have shown that the LORD Tool:

- Reduces controller work load
- Reduces of the rate of under-spaced pairs
- Increases runway throughput...

... even if not combined with runway throughput enhancement solutions
Leading Optimised Runway Delivery is not “only” an integration system.

This can be explained by the results of a dedicated EUROCONTROL survey of the separation delivery in various EU airports (averaged separations, standard deviation and a rate of under spacing).

**Observed H-M pair separations**

**Observed M-M pair separations**
Optimised Runway Delivery Tool is not “only” an integration system

This can be explained by the results of a dedicated EUROCONTROL survey of the separation delivery in various EU airports (averaged separations, standard deviation and a rate of under spacing)

Deduced distribution of H-M pair separation delivered in peak hours

Deduced distribution of M-M pair separation delivered in peak hours
Optimised Runway Delivery Tool is not “only” an integration system

This can be explained by the results of a dedicated EUROCONTROL survey of the separation delivery in various EU airports (averaged separations, standard deviation and a rate of under spacing)

Deduced rate of H-M pair under-spaced

Deduced rate of M-M pair under-spaced
Optimised Runway Delivery Tool is not “only” an integration system

The LORD tool reduces standard deviation of the separation delivered what has a positive effect on the under spacing rate...

Projected effect of LORD Tool:
Reduction of H-M under-spacing rate maintaining same r/w throughput (same averaged separation)
The LORD tool reduces standard deviation of the separation delivered what has a positive effect on the under spacing rate... but also on the runway throughput.

Projected effect of LORD Tool:
Reduction of H-M under-spacing rate maintaining same r/w throughput (same averaged separation)

Projected effect of LORD Tool:
Increase of r/w throughput (reduction of the averaged separation) maintaining same M-M under-spacing rate
Summary

The EUROCONTROL Runway Throughput Enhancement Program is a system based vision

The LORD system:

- is a key enabler supporting all runway throughput enhancement solutions
- allows Controllers to deal with adaptive separations and complex procedures
- reduces Controller work load
- reduces the rate of under-spaced pairs
- increases the runway throughput even if not combined with runway throughput enhancement solutions
Summary

SESAR-1 LORD Tool Development

At the end of SESAR-1:

- Time Based, Weather Dependent and Pair Wise Separations solutions will be mature
- An industrial LORD prototype will be validated
- Generic Multi-factors modelling of aircraft speed profiles will be available, and
- Guidelines for local customisation of this generic model will be produced
Summary

SESAR-2020 L ORD Tool development

In SESAR 2020:

- Enhanced Approach Procedure and Runway Occupancy Time prediction will be developed
- An extension to departure phase will be considered
- Big data algorithm and Machine Learning approach will be considered for defining aircraft speed profiles
Question?