# Analysing the Impact of Automation on ATM Resilience – Methodological Approach to Transforming Qualitative data to Numerical Indicators of Resilient Performance

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## Background

- The European ATM Masterplan, details the strategy for automation and the evolution of digitalisation in ATM solutions. This proposes changes in the envisaged concept and methods of operations in the ATS service provision network wide.
- The nature of these changes introduces new methods of working, of managing and controlling air traffic flows, increasingly diverse aircraft operation and new philosophies of the concept of operations.
- FARO's WP5 explores the ATM system, both in its current and envisaged form from the perspective of resilient performance.

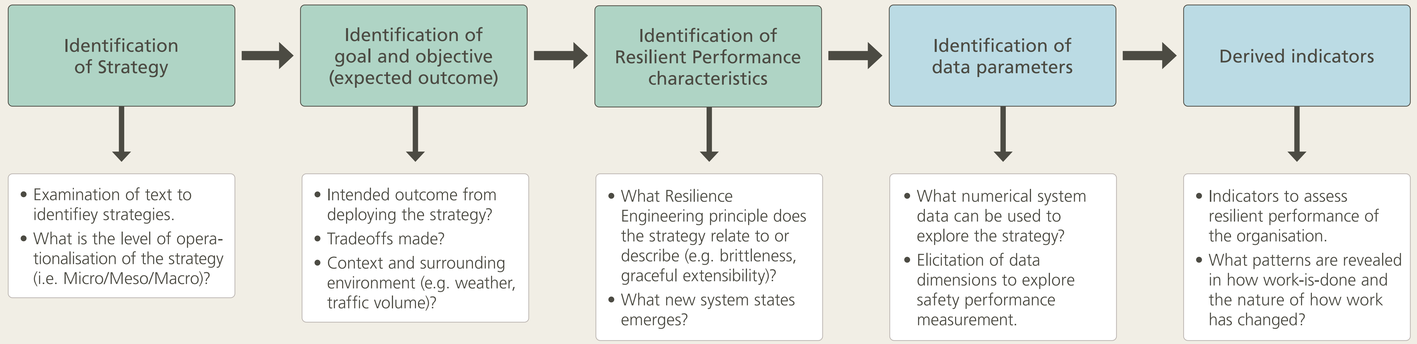
## Methodology

- WP5 adopted a methodology to enable the quantification of the changes that occur in the work system, which is pursuing sustained adaptability at scales in the presence of performance variability through exploring adaptation, trade-offs etc of the macro-cognitive work system.
- The methodology is based on transformation of qualitative data obtained through interviews with practitioners and desktop review into quantitative data to be used in evaluating the impact of new solutions on the resilient performance of an ATC sector.

## Expected Results & Conclusion

- Outcomes from the evaluation/analysis of the numerical data are expected to reveal resilient properties and changes to resilient performance – both new enhancements as well as weaknesses of the new system (Organisation 2) compared to that of the old system (Organisation 1) that support sustained adaptability.
- Does the new Organisation (2) support or create adaptive capacity that facilitates and enables resilient performance and sustained adaptability?

## Visual description of the methodology




## An Illustration of the process

| Strategy | Description of Strategy | Resilience Area | What do we want to analyse? | Data parameter | Indicators | Data transformation |
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| Pursuit of optimality | Controllers delay descending traffic by not following level restrictions, leaving a/c to continuous descent, or left at cruising level for longer. | • Graceful extensibility – How resilience is sustained at the boundary condition.<br>• Explore adaptive behaviour: Controller's ability to adapt to the operating environment by managing their task load to sustain multiple activities. | • Controllers' degree of freedom to manage workload – Is the degree of freedom enhanced or reduced in the new organisation?<br>• Use of opposite direction levels - ODLs (i.e. semi-circular rule).<br>• Trade-offs and prioritisations. | • Traffic counts, vertical profile (gives idea of FL changes) compared with references.<br>• Top of descent point for traffic flows e.g. Inbound BCN, inbound LEPA.<br>• How many a/c are maintaining a cruising level that is an opposite direction FL to the direction of traffic (i.e. FL 320).<br>• Sector configurations. | • Frequency of use of opposite direction levels (ODL) as intermediate cleared level or as a cruising level – The use of FL320 as an assigned East bound level.<br>• Variations of top of descent points to achieve defined coordination conditions (standard transfer levels) for specific flows of traffic.<br>• Trade-offs and prioritisations: Number of level offs in the vertical plane for a/c climbing and descending. | • a/c in sector N cruising at even FLs: e.g., 320, 340, 360, etc on a heading between 000 degrees and 179 degrees.<br>• For a/c entering via xxx and leaving sector Sy via exit point ppp, the number of level changes per flight to the RFL or pilot requested RFL.<br>• For a/c entering via entry point aaa, bbb, ccc the route clearances (track miles) between the nominal flight plan route and the actual track flown. |

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