### Research Questions

Can the resilience of a joint human-machine system in ATM be increased through a more flexible allocation of authority between human and machine?

### Research Scope

The capability to identify what is the best way to share control authority between systems and humans remains, as of today, one of the main relevant topic for which solutions have to be developed in view of a resilient air transportation system. This is an ever increasing need when one takes into consideration the growing request for the integration of Remotely piloted/Unmanned aircraft in the managed airspace system and the expected introduction of personal air vehicles in the transport system integrating with current categories of transportation aircraft. The project starts by defining an overall 2050 ATM expected scenario, in which high automation is available and functions to be allocated between humans and systems are clearly identified. A composite measure of resilience, based on ICAO KPAs, is then proposed for the application in the project. Following this, SAFECORAM will identify suitable non-nominal, abnormal and emergency conditions, leading to specific degraded scenarios. These scenarios will be assessed through a methodology, to be developed starting from failure mode analysis techniques but specifically extended and designed, aiming to provide the assessing of the ATM performance level still available in each of the identified degraded modes. The concept will be based on an evaluation of residual system performance, information availability, system and human performance models, allocating task execution on the basis of result evaluation of which is the most performing element (human or system). The benefits of such flexible authority allocation on the residual system performance and hence resilience will then be quantified. It is proposed to then build a software simulation environment to validate the concept with reference to a meaningful highly automated ATM scenario.

### Research Results

The expected research results of the project are a prototype SW environment implementing the authority sharing concept of the ATM system and a simulation and validation report of the proposed concept on a relevant highly automated ATM scenario.

An innovative methodology to support control authority sharing will be proposed, with the aim to improve ATM system resilience, by allocating either to the automation or to the human the residual system functionalities in failure and emergency conditions. To identify the better functions allocation and authority distribution, both system and human performance model shall be available. Actually, in the scope of this study simplified human performance models will be used, leaving the concept structure available to integrate more advanced human models for future developments. The evaluation scenarios will be implemented in a SW environment, and SW simulations will be used to validate the proposed concept.