The project PARSIFAL
("Prandtlplane ARChitecture for the Sustainable Improvement of Future AirPlanes") has been funded by the European Union under the Horizon 2020 Programme.

The project consortium has been coordinated by University of Pisa (Italy), whereas the partners are ONERA (France), TUD (Netherlands), ENSAM (France), DLR (Germany) and SkyBox Engineering (Italy).

In addition, an external Advisory Board composed of experts coming from academia, aircraft manufacturers (Leonardo, Airbus), airport management companies (Milan and Tuscany airports) and airlines (KLM) has supported the research activities.

Larger aisles for faster passenger boarding and deboarding operations.

Possible integration of ultra-high bypass ratio engines.
The project has achieved all the results expected, over-performing in terms of achieved TRL since flight test on a radio-controlled 1:38 scaled model have been carried out in order to assess the flight behaviour at low speed conditions. The final TRL achieved is above 4.

These benefits are the results of the aerodynamic advantages due to the PrandtlPlane configuration adopted, which minimizes the induced drag among all the possible wing system for given wingspan and total lift.

All the additional advantages coming from lighter materials, greener propulsion systems, more electric solutions, etc. have not been taken into account in such analysis; therefore further improvement can be obtained by combining the PrandtlPlane technology with other innovations.

MAIN FLIGHTPATH 2050 GOALS

Reduction of fuel consumption of more than 15% per passenger-kilometre compared the competitor aircraft such as A320/B737 family aircraft.

Reduction of the Direct Operating Costs (DOCs) not less than 10%.

Up to 20% reduction of CO2 and other pollutants per passenger-kilometre.

Full compatibility with present ICAO reference C airports.

Same turnaround time of the single isle aircraft with about 180 passengers.

THE FUTURE OF AVIATION
The project has been focused on the improvement of aircraft air traffic sustainability over short-to-medium ranges (<4000 km), where most of the aircraft in service today belong to the CASA Aerodrome Reference Code “C” category. Since this category will play a major role in the future air traffic increment, with growth factors up to 2x in the next 20 years, PARSIFAL has faced the challenge of designing a disruptive box-wing aircraft, called “PrandtPlane”, assessing the feasibility of its entry into service through the analysis of the benefits in terms of fuel consumption, environmental impact and direct operating costs reduction.

The main results achieved within PARSIFAL are the design and performance analysis of a PrandtPlane aircraft with up to 308 seats, same overall dimensions of competitors such as A320/B737 family aircraft, same turnaround time of competitor aircraft, reduction of CO2 and other pollutants per passenger-kilometre, reduction of direct operating costs. In addition, the project has investigated the adoption of innovative design tools and procedures for the PrandtPlane design, the integration of engines with ultra-high bypass ratio, landing gears and built-in air stairs.

Among the novel features of the PrandtPlane, it is worth citing the double-aisles cabin which allows to accommodate more than one luggage per passenger, a longer cargo bay capable of embarking more containers in comparison to competitor aircraft and provided with a front on a rear door, for simultaneous loading and unloading operations.

Longer and more flexible cargo bay due to peculiar fuselage-Wing intersection

Cargo bay of a conventional aircraft is interrupted by wing structure