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UNIFIER19: From TLAR to a winner of a concurrent conceptual design competition

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ABSTRACT:

One of the major challenges in the implementation of Europe's Flightpath 2050 vision, that envisages that virtually all EU citizens shall reach any continental destination in less than four hours, door to door, by the year 2050, is to provide enhanced mobility solutions to regions without adequate transport infrastructure. Those regions may share common disadvantageous topographical characteristics that prevent building ground infrastructure or were simply left out of the investment strategy in the past due to low population density.

Regardless of the reason, substantial financial investments would be required to establish an effective regular ground transport network (highways, fast railway, …) to meet the 2050 plan and the environmental implications of such network will not be negligible.

UNIFIER19 investigates a new aircraft concept for passenger and cargo transportation on short and very-short haul routes, that would provide communities with a new mobility solution by exploiting existing, sparse, and underused small airport network and without overwhelming investment burdens for new ground infrastructures. In addition, this aircraft would provide a zero-emission environmental footprint, thanks to its hybrid fuel-cell/battery propulsion system.

An exhaustive market research was performed on Belgium, Italy and Latvia territory, representing high-, mid- and low-ground transportation density regions in Europe respectively. The research was focused on two mobility services: the microfeeder and the miniliner. The microfeeder service is intended as a hub-to-spoke air transportation service, used to feed major airports from smaller cities or open country territories, whether the miniliner service would provide an inter-city connection.

The market study findings became a basepoint for top level aircraft requirements (TLAR), which were upgraded with 2025 technological assumptions. An interesting result from market study that indicated an average block range of 350 km (one hop) resulted in a specific multi-hop mission requirement which also eliminated the need of refueling infrastructure on all small airports in the network.

The next step was a down-selection from all possible combinations of airframe configurations and hybrid electric architectures that were considered potentially beneficial by considering technological complexity and functional compatibility between aircraft building blocks. The most promising configurations were sized in one of two independent conceptual design loops and subsequently cross-checked by the other design loop. This approach not only provides cross-validation of the conceptual design loops but also ensures that results from each loop's component, albeit implementing different tools, predict similar values.

Finally, a winning design was selected based on noise emissions evaluation, production and operating cost analysis and qualitative structural, manufacturability and certifiability assessment. Due to its liquid hydrogen powertrain system and distributed electric propulsion configuration, the design will enable establishing a quiet and green enhanced mobility service with minimal ground infrastructure investment.