Current aircraft development programs are realized as collaborative and multi-organizational design processes. A major challenge hampering cost effective design processes is the integration of multidisciplinary competences within the so-called virtual enterprise. The challenge is even greater when the required design services are provided by heterogeneous teams of specialists that are distributed among different organizations, and across nations. On the other hand, by nature, individual SME, IND, RES and HES alone can neither establish all the necessary competences nor system
competence. Therefore, the development of a “more competitive supply chain” is the key-enabler to deliver innovative aircraft products in a time and cost-efficient manner.

The state-of-the-art Multidisciplinary Design and Optimization (MDO) capabilities relies on high performance computing infrastructures, efficient optimization strategies, sophisticated simulation-based analyses in all the flight physics domains, and robust process management frameworks. Nevertheless, the exploitation of the full MDO potentials for the development of a complete aircraft is still an open challenge. Analyzing the current generation of MDO design systems, the AGILE Consortium has identified that major obstacles are largely related to the efforts required to setup and deploy complex collaborative development process.

AGILE ambition is to achieve the reduction of 20% in time to converge the design of an aircraft and a 40% in time needed to setup and solve the multidisciplinary problem in a team of heterogeneous specialists. Hence, the overall AGILE project objective is to achieve a significant reduction in aircraft development costs through a more competitive supply chain able to reduce the time to market of innovative aircraft products.

The overall project objective is translated into the following 4 technical objectives:
1. the development of advanced MDO techniques, and effective setup and integration methodologies in the design process reducing the convergence time in aircraft optimization
2. the development of processes and techniques for efficient multisite collaboration in overall aircraft design teams
3. the development of knowledge enabled information technologies to support interdisciplinary design task by processes formalization and automation
4. to develop and publish an open MDO test suite

The composition of the AGILE consortium reflects the heterogeneous structure characteristic for today’s aircraft development teams and virtual supply chains: including airframe OEMs, suppliers, as well as specialist design teams. Hence, multiple collaborative scenarios are formulated and resolved during the project.

**Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far**

AGILE project has developed the next generation of aircraft Multidisciplinary Design and Optimization processes, which target significant reductions in aircraft development costs and time to market, leading to more cost-effective and greener aircraft solutions.

AGILE has formulated a novel design methodology, the so called “AGILE Paradigm”, accelerating the deployment of collaborative, large scale design and optimization frameworks, and especially:
1. Accelerating the setup and the deployment of distributed, cross-organizational MDO processes
2. Supporting the collaborative operation of design systems: integrating people and tools
3. Exploiting the potential offered by the latest technologies in collaborative design and optimization

The AGILE Paradigm can be defined as a “blueprint for MDO” guiding the deployment and the
execution of collaborative MDO processes for complex products practiced by cross-organizational design teams, distributed multi-site, and with heterogeneous expertise. The AGILE Paradigm provides a methodology which prescribes a series of questions and practices to facilitate the deployment of an MDO system, it indicates how to structure the development of a complex product, it defines the roles of all the stakeholders engaged in the development, and it indicates how to streamline the interfaces and the interactions within the entire supply chain.

The AGILE Paradigm methodology has been implemented and proven to reduce the time and associated costs for designing conventional aircraft and in the design of seven novel aircraft configurations that are expected to enter service between 2035 and 2050.

In addition, AGILE has created the “AGILE novel aircraft configurations database” comprising information and digital models and extensive results relating to these seven novel aircraft configurations. This resource provides valuable information for future research into new aircraft configurations. At the same time, the project has delivered the “AGILE Open MDO suite” which contains the AGILE developed technologies and will enable a large number of organizations to access AGILE innovations.

AGILE’s value to the aviation industry has already been recognized by its peers. The project has received the “International Council for Aeronautical Sciences (ICAS) Award for Innovation in Aeronautics 2018”. Previous recipients have included aircraft programmes in multi-national environment. As consequence, a special session has been arranged at the ICAS conference, as well as an award key lecture for a large audience formed by all the key players in the aviation industry.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

The AGILE Consortium has successfully demonstrated the application of the novel AGILE methodology and technologies with the design and the optimization of transportation aircraft products.

The AGILE Open MDO suite contains the AGILE design and optimization technologies, providing accessibility to a very large sale number of organizations and applications, even beyond the aeronautical applications. The AGILE developments will enable the design of aircraft configurations having the potential of a substantially reduced environmental impact. The AGILE solutions have been applied to 7 novel aircraft configurations, to demonstrate the potentials of the developed technologies on diversified medium-term, and long-term products. The AGILE configurations database containing the main models and results of the unconventional configurations has been released as open access for further exploitation activities. Therefore, all the results available will enable to extend the knowledge, and mature the TRL on aircraft configurations with high relevance for future applications.

At the same time, the need to introduce collaborative MDO techniques within educational activities is also well recognized by the Academic, Research and Industry communities. The AGILE initiative “AGILE Academy” has been conceived to infuse into the academic organizations and educational
environments the AGILE methodology and technologies. The activities reached out more than 15 external organizations world-wide distributed, contributing to forming the next generation of professionals in aviation.

AGILE’s key outcomes will maintain the competitiveness of the European Aeronautical industry by contributing to the development of streamlined design processes and the creation of a network of technology clusters that will strengthen collaboration between industries, universities and research institutes.

Furthermore, AGILE has contributed to establish and strengthen the collaborative MDO community by organizing multiple AGILE dissemination and exploitation initiatives.
AGILE Novel Configurations

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