# PRELIMINARY SUB-SYSTEMS DESIGN INTEGRATED IN AN MDO FRAMEWORK

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**Abstract.** The aircraft design is a complex subject and one of the reasons is the several and completely different design disciplines involved in the project. Many efforts are spent to harmonize and optimize the design trying to consider all disciplines together with the same level of detail. Within the ongoing H2020 AGILE research, an aircraft MDO (Multidisciplinary Design Optimization) process is setting up connecting several design tools and competences together. Each tool covers a different design discipline such as aerodynamics, structure, propulsion and systems. This paper focuses on the integration of the sub-system design discipline with the others in order to obtain a complete and optimized aircraft preliminary design. All design parameters used to integrate the sub-system branch with the others are discussed as for their redefinition within the different detail level of the design.

The aircraft initial design is one of the most important phases of aircraft development since in a short time engineers have to mature a competitive and innovative product that should be considered nearly defined at the end of this phase. The development of an advanced and competitive aircraft should include MDO (Multidisciplinary Design Optimization) techniques to reduce the convergence time and to obtain an optimized design considering all main disciplines in a harmonized way. The final result should be a design more globally optimized than older projects in which a local optimization inside each technical specialities were pursued. The main difficulty in following this approach is to face the usual and unavoidable conflict between disciplines where the optimal solution in one speciality implies a lacking design for the others.

The main aim of this paper is to define and explain which parameters of the design space should be used as interface between the preliminary sub-systems design and the other specialities. The parameters involved are of great interest in aircraft design since they mainly influence the overall project. All these parameters represent a remarkable impact since sub-systems represent almost the 30% of aircraft empty weight and the 15% of the engine total power. Moreover, these parameters must change with the level of the design detail as for tools and specialities involved. Furthermore, this paper is focused on the impact of sub-systems technologies and architectures, such as more or all electric, on the other disciplines. The defined design parameters range from the sub-systems weight, volume, performances to the engine power off-takes required as secondary power with increasing level of details. During the first design iterations, the sub-systems are globally considered. Afterwards, also the main equipment of each sub-system are taken into account.

This work is carried out within AGILE H2020 European research project of which, one of the main purposes is the employment of MDO techniques to enhance the project competitiveness of standard and innovative aircraft configurations.

**Keywords**. Multidisciplinary Design Optimization, Aircraft Sub-system Design, Design Space Parameters