The Selective Laser Melting (SLM) process provides huge advantages for aircraft components like valve blocks and structural parts. In this project funded by the BMWi – “Federal Ministry for Economic Affairs and Energy”, the benefits of substituting conventionally manufactured parts by additively manufactured parts will be examined and quantified. The scopes are, reducing costs, weight and time in comparison to the traditional design and the conventional manufacturing method. Therefore, some conventionally manufactured parts by additively manufactured parts will be examined and quantified. The scopes are, reducing parts.

In this case, a performance parameter was developed and validated (Fig. 1). Therefore several mechanical properties like hardness, tensile strength and fatigue behavior were determined. The gained knowledge of the different working steps were merged in the topology-optimized component to demonstrate the possibilities of Additive Manufacturing as a key technology of the future.

Since the project started in January 2016, the fundamentals for the different working steps are finalized. The material database is discussed and the programming of a decision support tool was done. Furthermore, the initial steps for the determination of mechanical properties of the structures to be examined were finalized. A knowledge base of the behavior of lattice, composite, support structures, and the influence of the part position on the building plate has been established. In addition to that, powder ageing effects in different build jobs with the same powder were analyzed. Investigations on adapting the default process route for Ti6Al4V and for increasing the building speed through parameter optimization has been done. Therefore the limits and potentials of HIP processes were investigated and the influence of the performance parameter on residual stresses and distortions were determined (Fig. 2).

Conclusion
In summary, it can be said that the project showed that the basis for the success of additive manufacturing is a diligent component selection. The component selection determines the success of additive manufacturing. The selection of materials, processes, and design considerations are critical to the success of additive manufacturing projects.

The fundamentals for an Additive Manufacturing material database for innovative structures and performance parameters for Ti6Al4V are developed. Therefore, several lattice structures and support structures were analyzed. The most promising structure was the gyroid structure (Fig. 3), which has many potential as support structure. Moreover, investigations working on improving the process, which includes increasing the building speed of the SLM process and to develop fast and stable process routes that can be used for serial production, were acquired. The intention was to reduce the processing time in every stage of the process chain, particularly in the Additive Manufacturing process. The validation on component level shows a time saving potential of around 25% in consideration of the total processing time.

Workpackages
The project is divided into two work packages, the first work package works on identifying promising aircraft components and to adapt a trade-off methodology to rank these parts. According to this trade-off methodology, a decision scheme for future decisions is developed with a complete description of process chain mapping possibilities and influencing factors for the process. Within the scope of this work package, about 20 components were analyzed and ranked. For a detailed elaboration in this project, one component was identified and topology optimized concerning the requirements of the conventional component (comp. Fig. 1). A weight reduction of 35% was achieved while having the same stiffness.

The second workpackage works on the development of a stable process route, based on the aim of increasing the building speed.

ADDITIVE MANUFACTURED LIGHTWEIGHT STRUCTURES FOR CIVIL AIRCRAFT COMPONENTS

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**PROJECT OVERVIEW**

**DURATION**

01/2016 – 01/2019

**PARTNER**

- Liebherr Aerospace Lindenberg GmbH

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