

Proposal for Focused Collaborative Project (CP-FP, Level 1) under call AAT-2013-RTD-1 of the 7th Framework program of the European Commission to contribute to the “greening” and “cost-efficiency” of future air transport by 2020 and beyond: <http://pentakit.ktsystems.de>

Title: Product ENabling Technologies for a lightweight, modular, Automated, real-time and wide area inspection network-KIT (PENTAKIT)

- To develop a new class of on-board, certifiable structural health monitoring (SHM) technology
- Enabling the design of significantly and radically weight-reduced Aerostructures

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The new class of SHM system technology would require

- **ten to thirty times less weight and cost to reliably monitor the structural integrity of future highly-efficient, radically weight-reduced aircraft structures, thereby**
- **keeping and increasing safety at moderate maintenance cost.**

With PENTAKIT installed on-board an aircraft, it would result in significant net weight-savings and a multiple return on investment through cost- and CO₂-savings in terms of fuel savings.

The CO₂-emissions of future aircraft and direct operating costs have to be reduced significantly. The 2020-aircraft will have to **exploit the full structural capability of new highly-efficient structures**. In the long term, high-energy fuel types will require further efficiency-increase. Damages become more challenging to detect with respect to visibility or accessibility. To avoid safety risks, more economic and reliable inspections at shorter intervals are needed and the actual influence of loads on potential damage growth becomes more important than can be predicted by tracking flight hours and cycles.

PENTAKIT develops a new class of certifiable onboard structural health monitoring technology SHM, based on **cascadable piezo-/optical-networks**, together with the design process of highly-efficient structures to enable **continuous cost-efficient automated inspections at short intervals** and to track operation loads at a precision that allows safe decision margins from early damage detection to economic repairs.

To radically reduce weight (being main factor in aircraft design) future certification has to show a defined reliable interconnection between the monitoring system and the structural health due to design, analysis, testing and verification (flight testing). Airworthiness requirements, as of today, for different safety factors (depending on future materials) for structural design have to be discussed with EASA and FAA. This promises real weight reduction while keeping the required aircraft structure safe during operation. PENTAKIT develops the necessary 2020-roadmap to certification and takes care that the integration of PENTAKIT in the structural design process is initiated. The results of PENTAKIT will be the **certification roadmap, certifiable sensor-network technology, multidisciplinary “PENTAKIT-economic structural design principles”, new validation methods for certification** and the “beyond-PENTAKIT-project” **roadmap to exploitation** of the PENTAKIT technology.

PENTAKIT will stimulate and accelerate the **industrial take-up** of applications of next generation tools to more effectively enhance structural health monitoring equipment; significantly reducing risks and energy consumption, while keeping maintenance costs moderate. PENTAKIT will contribute to **position the European industries (large and Small & Medium Enterprise SME) ahead of competitors** in North America and Asia by capitalizing on advances in the new class of on-board structural health monitoring in aeronautical science and MRO technologies to **offer the most environmental friendly and most affordable and safest aircraft structures**. Through its strong SME-character, the eight-national PENTAKIT-consortium (**GE, CH, ES, IT, LV, NL, TK, UK**) with its 15 members takes benefit from innovative research and development directed towards fast exploitation of its product potential to strengthen the aircraft industries’ supply chain. The consortium embraces aircraft industry, maintenance, suppliers, technology providers and academia.