PROJECT

MULFUN

Multifunctional Structures

**Funding:** European (6th RTD Framework Programme)

**Duration:** Jan 2005 - Feb 2008

**Status:** Complete with results

**Total project cost:** €2,423,029

**EU contribution:** €1,253,200

**Call for proposal:** FP6-2003-AERO-1

**CORDIS RCN:** 72841

**Background & policy context:**

The need to reduce cost is a driver for weight- and volume-constrained design on aircraft and satellites. In the last few years, lightweight composite materials have been increasingly used to reduce the structural weight of equipment components. However, concentrating solely on structural mass reduction does not lead to further reducing equipment mass, because the structure typically represents as little as 10 to 15% of the total mass. The envisaged solution was to design structural elements that can integrate multiple functions, known as multifunctional structures (MFS).

**Objectives:**

The project objective was the development of lightweight, fully integrated advanced equipment for aircraft and spacecraft (avionics electronic housings). Breadboards, based on the MFS technology, with a weight and volume reduction compared to their aluminium counterparts will be developed.

A planar array antenna and a composite-based housing that integrate thermal, electrical and structural functions was developed. Through the proposed MFS solution, a 30% weight saving and a 50% volume reduction of the equipment was expected. The applicability of the MFS technology in the aerospace industry was also be assessed.

**Methodology:**

MULFUN is a specification-focused, innovation-type project, with a building block approach, according to which four breadboards will be designed and manufactured. The work plan was structured into three main phases.

The first phase began with a general technology review of the MFS concept and the associated technology requirements (Work Package 1). After the assessment, two systems based on the two different approaches in thermal control (active and passive systems) were designed, manufactured and tested in two technological panels (Work Packages 2 and 3).

The second phase dealt with two different applications, which evaluated the technology developed in the first phase. The first design concept chosen was based on a planar array antenna for aircraft communications (Work Package 4). The second one was a representative power electronic housing (Work Package 5), addressing the problems of assembly, EMC shielding and the integration of dummy electronics boards.

The third phase (Work Package 6) covered the exploitation aspects of the innovation produced.

**Parent Programmes:**

FP6-AERO-1.1 - Strengthening competitiveness

**Institute type:** Public institution

**Institute name:** European Commission
**Funding type:** Public (EU)

**Lead Organisation:**

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<td><strong>Address:</strong> Paseo Mikeletegi, Parque Tecnologico Miramon 2 20009 SAN SEBASTIAN Spain</td>
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<td><strong>Organisation Website:</strong> <a href="http://www.inasmet.es">http://www.inasmet.es</a></td>
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**Partner Organisations:**

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<th>Rhe Microsystems GmbH</th>
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<tr>
<td><strong>Address:</strong> Heidestrasse 70 RADEBERG Germany</td>
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<tr>
<td><strong>Organisation Website:</strong> <a href="http://www.rhe.de">http://www.rhe.de</a></td>
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<td><strong>Address:</strong> Technoparc 10 - 10 rue Jean Bart 97431 LABEGE France</td>
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<td><strong>Organisation Website:</strong> <a href="http://www.epsilon.fr">http://www.epsilon.fr</a></td>
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<td><strong>Organisation Website:</strong> <a href="http://www.htsdd.de">http://www.htsdd.de</a></td>
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Key Results:

During the project, four breadboards were developed.

The technologies required for the MFS design were developed and successfully applied in the four prototypes.

In all the cases, good mechanical, thermal and electrical performances were obtained. EMC-EMI and radiation shielding aspects have also been considered. Different approaches in order to obtain a shielding behaviour comparable to a 2 mm thick aluminium plate have been evaluated.

Mass savings of around 35% in the phase array antenna and around 65% in the electronic box have been obtained. Therefore, the tasks and objectives of the MULFUN project have been successfully fulfilled.
**Technical Implications**

1. Multi-functional structural elements based on high-k carbon materials

   - **Description**
     
     The developed technology consists of lightweight structural elements with high thermo-mechanical performance, based on the use of advanced composite materials with high-thermal conductivity high-performance graphite fibers and other high-conductivity carbon products, and on integrated design and manufacturing approaches.

     Thermo-structural integration provides the capability of managing increased power density applications and permits mass saving and simplification of the layout, additionally supporting standardization. The need for dedicated thermal hardware is minimised and the necessary hardware, in turn, is embedded into the structure as much as possible.

     The acquired knowledge is potentially applicable and advantageous for structural support panels and equipment envelopes within a wide range of aero-space applications.

   - **Market application**
     
     The technology is usable for the markets/applications as follows:
     - Space (radiators, solar arrays, active antennas, avionics, supports for dissipating payloads and optics)
     - Aeronautics (avionics, antennas)
     - Telecommunication

2. Frame-lid technology

   - **Description**
     
     The frame-lid package is a special housing technology of electronic circuits. This technology confines itself to the protection of circuit parts where it is necessary e. g. in case of mounted bare dies or printed resistor. The electronics circuit board is used as the package bottom. The frame and lid complete the housing. The result is a hermetically sealed package with a reduce weight.

   - **Market application**
     
     The packaging technology is usable for the markets/applications as follows:
     - Space
     - Avionic
     - Telecommunication
     - Industrial applications

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**Documents:**

- [MULFUN-Final Activity Report.pdf (Final report)](MULFUN-Final Activity Report.pdf)

**STRIA Roadmaps:** Vehicle design and manufacturing, Infrastructure

**Transport mode:** Air transport

**Transport sectors:** Passenger transport, Freight transport

**Transport policies:** Societal/Economic issues

**Geo-spatial type:** Infrastructure Node