# LIGHT-TPS

***Super Light-Weight thermal protection system for space application***

**FP7-SPACE-2013-1**

**GA Nº 607182**

***Kick-off Meeting***

28-29 May 2014

tecnalia Inspiring Business

**Project Coordinator: María Parco**
**TECNALIA**

# Project Overview

Duration: 01/12/2011 – 30/11/2014

# Consortium

| No. | Organisation Name | Acronym | Scientific Team Leader | Country |
|---|---|---|---|---|
| 1. [CO] | FUNDACION TECNALIA RESEARCH & INNOVATION | TECNALIA | Dr. Maria Parco | Spain |
| 2 | Frantsevich Institute for Problems of Materials Science of National Academy of Sciences of Ukraine (NASU) | IPMS | Prof. Gennadii Frolov | Ukraine |
| 3 | YUZHNOYE Design Office named after Mikhail Yangel | YUZHNOYE | Dr. Victor Tykhyy | Ukraine |
| 4 | Space Research Institute, NASU and State Space Agency of Ukraine | SRI | Prof. VitaliyYatsenko | Ukraine |
| 5 | Institute of electric welding named after Paton of NASU | IEW | Iu Falchenko | Ukraine |
| 6 | National Research Council of Italy - Institute of Science and Technology for Ceramics | CNR | Dr. Laura Silvestroni | Italy |
| 7 | ECM Space Technologies GmbH | ECM | Dr. Arnold Sterenharz | Germany |
| 8 | Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR). Institute of Structures and Design | DLR | Marius Kuetemeyer | Germany |

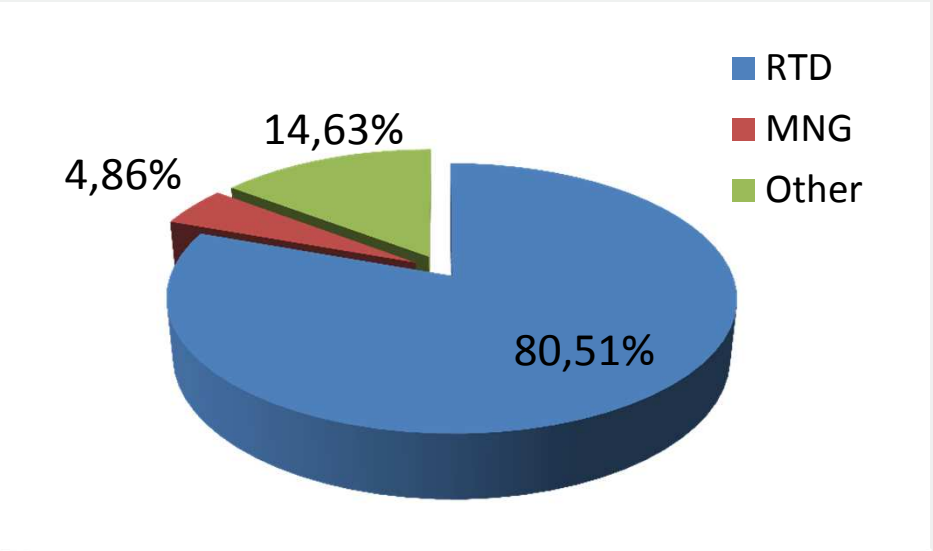
# Budget and Grant

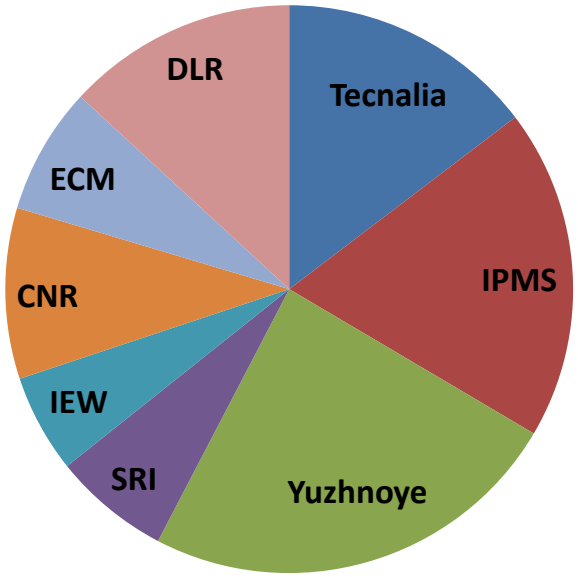
**Total budget: 2,741,033.40 €**

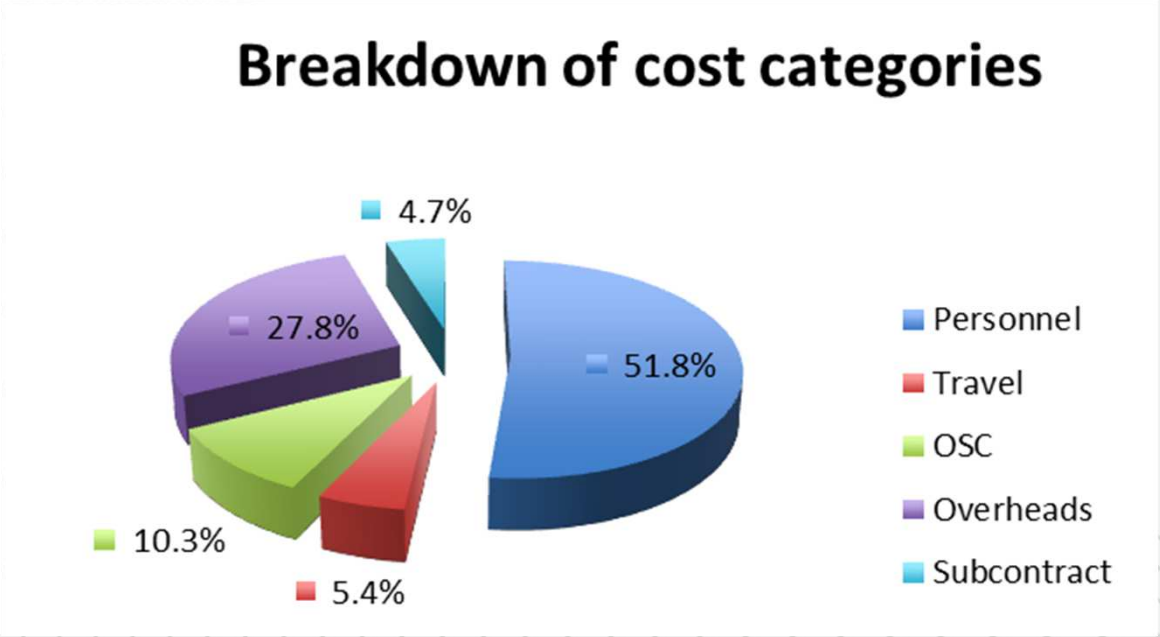
**Total Grant: 1,997,363.00 €**

**Start date: 01/05/2014**

**Duration: 36**



# Project scope

The project aims to the ***development of innovative materials and manufacturing technologies for the fabrication of a new generation thermal protection systems for future reusable space systems***. The fundamental novelty of the project is **combining metallic and non-metallic heat/corrosion resistant materials** in a particular way that allows a significant **reduction of the weight** of global system, while keeping the fundamental features of spacecraft components for atmosphere re-entry and hypersonic flights.

The project's efforts will be centred on the 3 major research challenges, namely:

- Development of **super lightweight heat resistant metallic TPS honeycomb frame**, incl.: (1) **nickel-chromium** alloy development with specific weight of ca. 7500 kg/m$^3$ and (2) development of **alloy based on niobium** with specific weight of 5830–6000 kg/m$^3$ and (3) **development of manufacturing technology for a three-layer honeycomb metallic frame** with specific weight of no more than 10 kg/m$^2$.
- Development of **erosion-resistant ultra-high temperature ceramics in the $ZrB_2$-SiC system**, to identify the most suitable composition to be applied as **coating on metallic and non-metallic substrates** (incl. optimization of the technology for the production of composite ceramic materials with microstructural features typical of plasma sprayed coatings, thermo-mechanical characterization of the ceramics).
- Development **of technology for the deposition of the most suitable UHTC composition** based on the $ZrB_2$-SiC system on metallic (Ni-Cr, Nb alloy) and non-metallic (C/C, C/SiC, UHTCMC) substrates of the TPS.

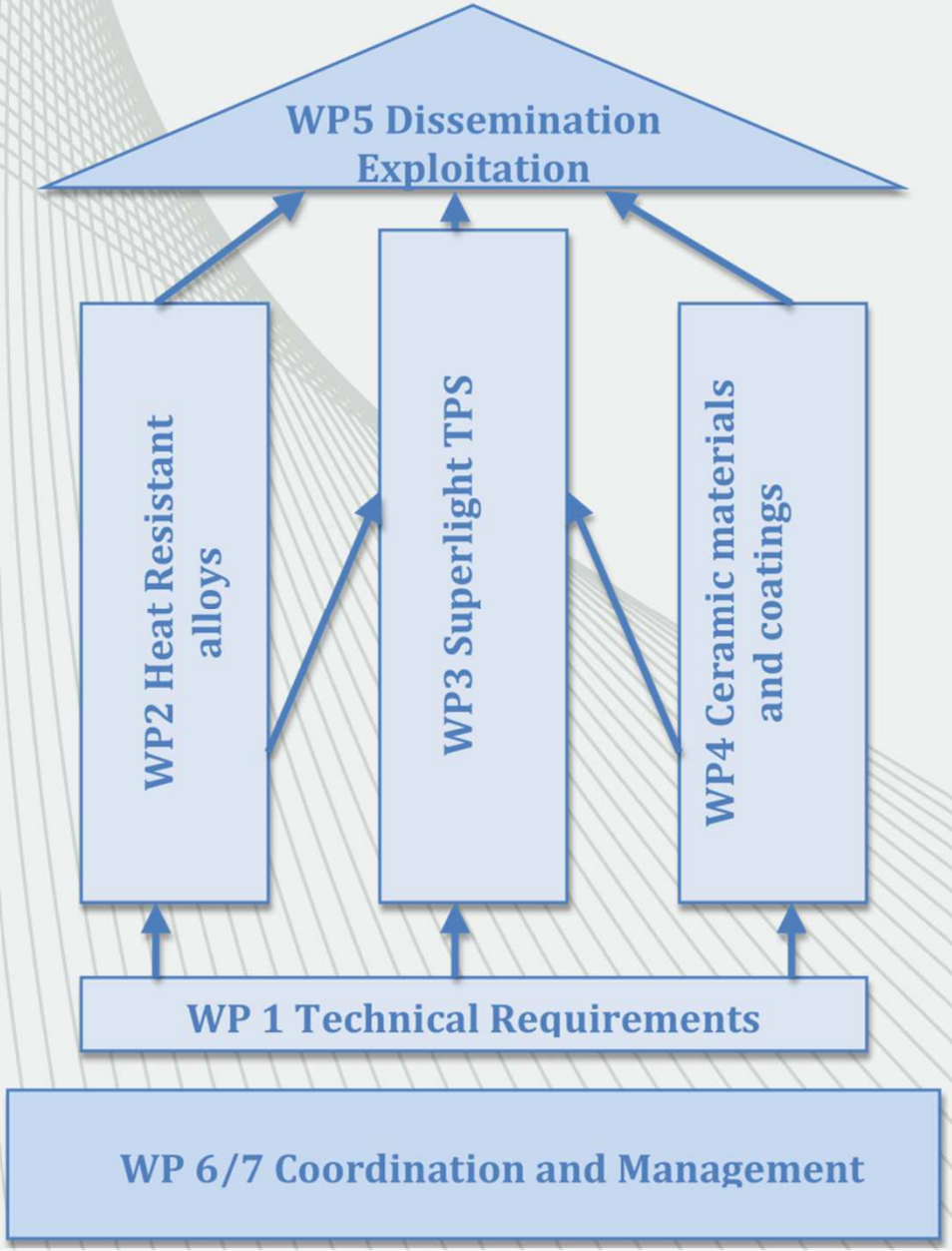
# Technical Objectives

- Identify at least 2 of the most advanced European projects concerned with the development of reusable spacecrafts and/or other space systems using TPS:
  - ➔ To study and systemize the system requirements for the TPS development: range from physical parameters (e.g heat resistance values for different elements of TPS, range of working temperatures, specific weight, resistance to different kind of impacts, etc.) to economic/maintenance parameters (cost per unit, maintenance costs, average number of flights survived, etc.).
- To research the mechanisms of secondary structures formation on a working surface of traditional nickel-chromium alloys (proprietary from IPMS) under high-temperature oxidation conditions → Correlation with the manufacturing technology with the aim of increasing their operational characteristics.
- To develop the manufacturing technologies for a new alloy based on Niobium, which possesses better exploitation characteristics (specific weight of 5830–6000 kg/m$^3$, improved corrosion resistance).

# Technical Objectives

- To investigate the respective physical processes and to develop new smart coatings of UHTC composites based on the $ZrB_2$-SiC systems:
  - ➔ Suitable for applications at the temperatures up to 2000oC
  - ➔ HT erosion resistance against heterogeneous gas streams containing hard and liquid particles
  - ➔ To investigate the processes of the secondary structures development on such surfaces during exploitation.
- To develop realistic prototypes of the TPS elements incorporating new materials, technologies and processes → 1) Tests and evaluation under relevant service conditions, 2) Assess to which extent the technical requirements have been met.
- To make the project outcomes available to the research communities and potential users (developers of future RSS and respective technologies) → Proper identification, documentation and protection of new knowledge and its transfer to the industry (at least 3 international patent claims).

# Project structure



# Indicative efforts (Person-months) per Beneficiary per Work Package

| | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 | Total |
|---|---|---|---|---|---|---|---|---|
| **Tecnalia** | 1,00 | 0,00 | 0,00 | 21,00 | 4,00 | 6,00 | 9,50 | 41,50 |
| **IPMS** | 2,00 | 23,00 | 9,00 | 25,00 | 3,00 | 4,00 | 0,00 | 66,00 |
| **Yuzhnoye** | 5,00 | 17,00 | 135,00 | 0,00 | 4,00 | 8,00 | 0,00 | 169,00 |
| **SRI** | 1,00 | 3,00 | 3,00 | 25,00 | 3,00 | 2,00 | 0,00 | 37,00 |
| **IEW** | 1,00 | 1,50 | 14,00 | 0,00 | 2,00 | 1,50 | 0,00 | 20,00 |
| **CNR** | 1,00 | 0,00 | 0,00 | 21,00 | 2,00 | 1,00 | 0,00 | 25,00 |
| **ECM** | 2,00 | 0,00 | 0,00 | 0,00 | 7,50 | 5,00 | 1,50 | 16,00 |
| **DLR** | 1,00 | 0,00 | 3,00 | 18,00 | 1,00 | 1,00 | 0,00 | 24,00 |
| **Total** | 14,00 | 44,50 | 164,00 | 110,00 | 26,50 | 28,50 | 11,00 | **398,50** |

## Contact person:

**Coordinator:** Dr. -Ing. María Parco
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