Programme for Research-Development-Innovation on
Space Technology and Advanced Research - STAR

ACTIVE MICRO-SHIELDS SYSTEMS FOR PROTECTION OF SPACE INFRASTRUCTURES

Acronym: Micro-Shields

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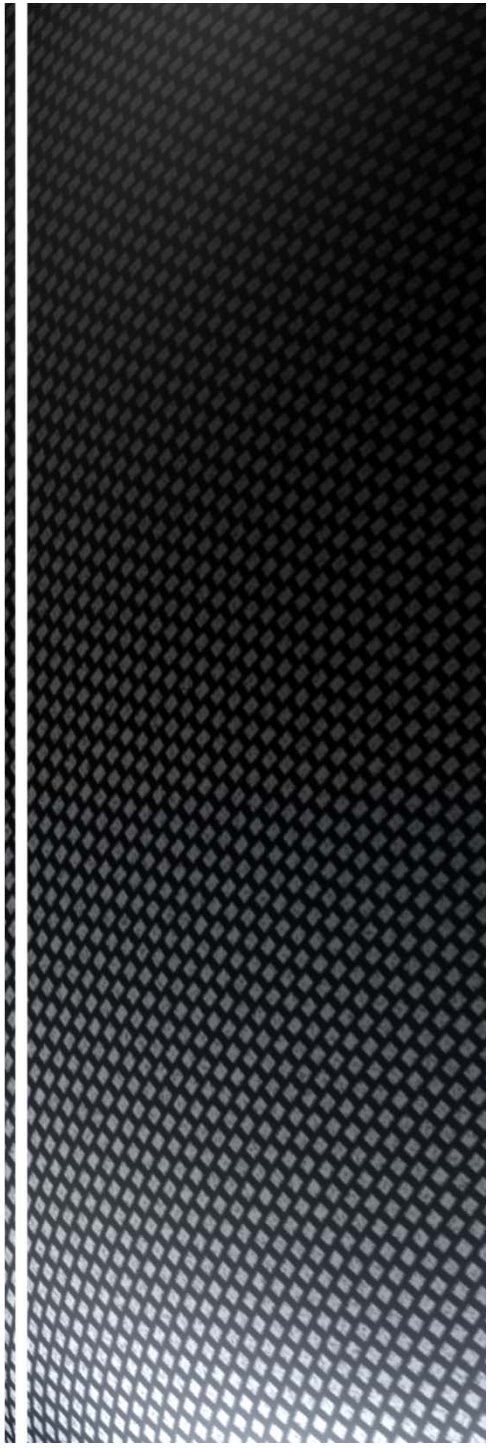

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- Partner organization: **EUROPEAN BUSINESS INNOVATION & RESEARCH CENTER S.A. – EBIC –**
- Partner team leader: **Dipl.eng. Simion Dascalu**

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- Project budget allocation: 800.000 Lei, and total budget about 962.400 Lei
- Coordinator IMT-Bucharest budget allocation: 498.000 Lei
- Partner EBIC budget allocation: 302.000 Lei, and co-financing: 162.400 Lei

- Short description of the project:
- This project research is part of a scientific development of innovative concept for Active Micro-Shields Method and System, with the purpose to improve protection against the high velocity micro-space debris, particles and solar flares dust, including the capability to decrease radiation exposure using the synergy with advanced nano- and micro-technologies, and will be produced based on micro-materials fabrication.
- This project is based on own advanced technical solutions for a structural protection against high velocity space debris, and particles travelling at very high speeds in the near space and around the human made space systems and space infrastructures.
- The active capacity of the proposed Active Micro-Shields© System is define by light speed action to wipe out any colliding particles by the energy being both expandable and re-chargeable, and is based on modular design to ensure structural safety to any potential impact damage or limited to the shields' impact area. System is assisted by the electronics in monitoring structural capacities, the energy used and/or available, providing a real time post impact damage assessment of the active shields' structure on affected areas and most important shows Active Micro-Shields structural integrity
- The project is addressing the research topics of the STAR Program 2012 as regarding the multidisciplinary and interdisciplinary scientific technology research and this is a boundary research in the area of active space shields method and system, offering a very narrow performance and high competitivity for the emergent Romanian space industry, as a joint cooperation of a private SME and a public research institution.

- Objectives:
- The project is addressing the research specific objectives of the STAR Program 2012 regarding the support and increased capacity of participation to several ESA operational programmes such as but not limited to the increasing the mission endurance of the scientific robotic exploration, the GNSS satellites or satellite for telecommunication and human space activities. This project is focused on the development of the space technologies, systems and space equipments very well suitable for all future aeronautics developments and other industrial activities.
- The proposal aims which demonstrate a clear long-term vision that is far beyond the state of the art for space technology and shielding, and is engaging within the high-risk innovative ideas rather than refinement of current scientific approaches. Project is expected to bring experience on the advanced technologies addressing research problems in the space domain by the SME and local aerospace industry.
- The key goals and associated challenges of this project research are: increased protection against the hazards of space environment, space safety techniques for survivability in deep space mission including protection against environmental influences and man-made micro space debris, and development of new materials, space technologies, fabrication capabilities, know-how and shielding methods.

- Estimated results:
- The project will deliver entirely new solutions for the EU space industry in general, and particularly for the Romanian Aerospace Industry, a critical space technology that will improve actual European strategic agenda for non-dependence, having a major impact on the space industry production developments, over space mission operational costs, space structure integrity, space safety, increased life-cycle and space mission endurance for all kind of space based services provide by satellite systems, ISS, robotic spacecraft systems, and during the future space exploration.
- Active Micro-Shields© System is proposed to be manufactured by ROMAERO S.A., the main aerospace player in Romania, in cooperation with EBIC, IMT-Bucharest and MINATECH-RO within ROMAEROSPACE Pole of Competitivity that was created around ROMAERO S.A. to bust its competitiveness in both aeronautics and space.
- The project results will be used to support our joint participation within the next Horizon 2020 and future ESA programmes and will support the national strategy to increase a national based innovation space industry competence and capability.
- Human resources involved: over 20 researchers or engineers (142 person-months)
- Start date of the project: November 2012 End date of the project: November 2014

- Work plan of the project:
- **Methodology and associated work plan:**
- The methodology used to perform all the works and activities of the present project is very well similar with the FP7 project proposals used by both EBIC and IMT during their research activities and projects of the last 2 years. The associated work plan is organized in seven work packages and each work package is arranged by task works, is broken in three logical phases during the whole implementation period of 24 months, and the result is the management structure of the project:
- **WP1 SYSTEM DESIGN SPECIFICATION AND SYSTEM ARCHITECTURE DEFINITION -** period 12 months;
- **WP2 CONCEPT MODELS & SYSTEM's THEORY -** period 20 months;
- **WP3 SYSTEM VIRTUAL 3D MODELS AND BASIC FUNCTIONAL 3D SIMULATION -** period 20 months;
- **WP4 RESEARCH RESULTS IPRs PROTECTION -** period 20 months;
- **WP5 SYSTEM MODELS MANUFACTURING -** period 22 months;
- **WP6 SYSTEM MODEL PRELIMINARY TESTING -** period 24 months;
- **WP7 DISSEMINATION AND EXPLOITATION PLAN -** period 24 months;

- Implementation status of the project:
- **Management structure and procedures**
- Objectives of the management structure and procedures are to have a better coordinated project and effective management involving the interests of the different partners and to reach the deliverables and research results and ensure a high quality of the work plan implementation, including communication with contract authority.

- **General Project Management** (Project coordinator: IMT) - This work will mainly be performed by the project manager, who is acting as the supervisor for legal requirements handed over by the financial agreement and in accordance with partnership agreement. The Project coordinator accountable manager will be responsible for all activities for implementation of the project proposal following specific tasks related to the project management:

- **Administrative Management** - the main actions for the administrative project management can be in generally summarized as the supervision of legal issues, IPR issues, tasks, work and other consortium matters. Regular (monthly) project management meetings with project partners and phase review meetings will be organised and executed. In close cooperation with scientific manager, quality and financial managers, the project coordinator performs the day-to-day management, resolves conflicts, monitors the work progress against the project plan.

- **Financial Management** - the main actions of the financial management activities will cover all verifying the cost statements against the progress reports and plan, signing off the payments and establishing traceability between effort and costs, cost categories. The partners cost statement will be reviewed together with the results from the individual audits and the funding will be distributed. Balanced in advanced project needs and requirements to avoid over running the allocation of budget and efforts.

- **Risk Management**, the project manager, scientific manager together with the quality assurance manager will perform the risk management activities. An initial risk assessment has been performed prior to the project and the results serve as baseline for the project's risk management plan. The risk management is a continuous task performed during the whole project runtime, and is incorporating assessment of risks and measures as well as definition and execution of risk recovery actions.

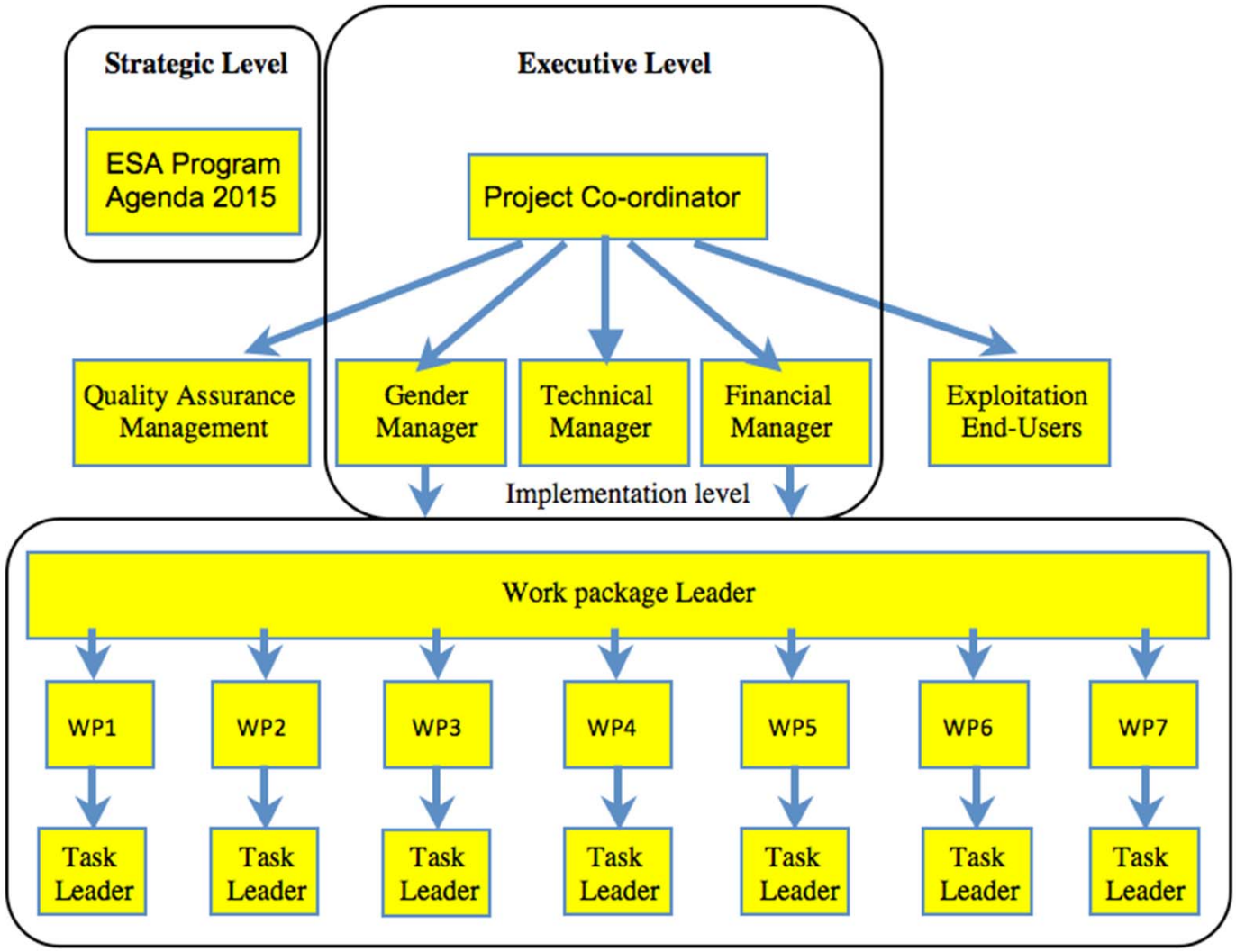
- **Support Activities** - are further support activities are the handling of the project documentation or establishing a complete views over the work progress and reporting coordination within the consortium.

- Implementation status of the project:
- **Risk Management -** Risk analysis and contingency plan (lessons learned)
- The project will maintain a Risk-Management program which will have be lead under the full responsibility of the project coordinator in collaboration with the technical manager. Overall risk assessment will be performed by the technical manager every 3 months and will be included in the project activity reports. Each risk will be evaluated following 3 main criteria (technical, schedule, cost) and their rank, multiplied by the probability of appearance will create the Risk-Factor degree. Risk Reduction Plans will be prepared for every risk above a certain defined level. The Risk-Reduction Plans will include specific activities that performing them might reduce the identified Program Risk. In particular, special milestones will be set annually in Implementation Plan to assess specific risks. These milestones will represent clear go/no-go points enabling objective project advancement and the Risk-level measure. In order to properly manage the financial risk the Project Coordinator is responsible for monitoring the financial status of relevant partners.
- There were no risks related to the management of the project and all the difficulties were mitigated with ROSA.

- **Quality Assurance Plan**
- A Quality Assurance plan will be established at an early stage of the present project implementation in order to ensure high & homogeneous quality in the Project Results and End-Products, as agreed by the partners in the consortium agreement. The Program will include several indicators such as: planning, milestones, reports and deliverables. A Project Configuration Control System will enabling precise identification and continuous tracking of project documents and software packages will support the implementation of the work plan and decisions of the Quality Assurance Manager.

- **Decision Making and Conflict Resolution Procedures**
- In order to ensure an efficient project management, all day-to-day decisions that do not affect the achievement of work package goals and the achievement of the overall project goals may be taken respectively by the work package leaders (implementation level) and by Executive Management Team (executive level).
- More specifically, technical issues are dealt with the technical manager and project coordinator although exploitation issues are dealt with the exploitation manager. For major decisions that may affect the overall project, the strategic level will support the executive level with appropriate decision proposals. All issues related to funding allocation, IPR and exploitation conditions will be handled by the executive managers itself. In all cases, and especially when it seems difficult to clearly state that a decision does or does not affect the objectives, ROSA representatives can be consulted for advice, at any time.

- Implementation status of the project:
- **Management structure and procedures**



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Gantt diagram with duration distribution of all workpackages

Year / WP	Etapa 2012	Etapa II / 2013						Etapa III / 2013						Etapa IV / 2014										
Month no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
WP1																								
WP2																								
WP3																								
WP4																								
WP5																								
WP6																								
WP7																								

- Work plan of the project:
- **Phase I. 2012 - Preliminary Study**
- Activity I.1 Preliminary Study Project Definition
- **Phase II. 2013 - Concept Research and System Design**
- Activity II.1 Preliminary System Design WP1
- Activity II.2 System Design Architecture WP1
- Activity II.3 Concept Models System's Theory WP2
- Activity II.4 System Virtual and 3D Models WP3
- Activity II.5 Research Results IPR Protection WP4
- Activity II.6 System Models Manufacturing WP5
- **Phase III. 2014 - System Concept Technology Definition**
- Activity III.1 Concept Models System's Theory WP2
- Activity III.2 Research Results IPR Protection WP4
- Activity III.3 System Models Manufacturing WP5
- Activity III.4 System Models Integration Test WP6
- Activity III.5 System Models Laboratory Test WP6
- Activity III.6 Dissemination and Exploitation Plan WP7

- Project's contribution to the goal of the STAR Programme
- **Expected impacts and added-value by addressing the objectives listed in the STAR programme 2012:**
- - specific niche identification for research, technology and industry at national/EU and international levels;
- - is able to define and identify future project proposals for participation to ESA operational programmes: PROBA III, PRODEX, NEOSAT has been identified and the project results will be further developed for use;
- - encourage developments and promotion of the national capacity for research, education and industrial in the areas of space activities, aeronautics industry, security and connected domains;
- - is improving partnership (cooperation and interaction model) between the research entities and industry;
- - interdisciplinary developments of research experts at the highest levels - continuing formation/practice;
- - is setting bases for top scientific production and increasing the up/down stream research quality levels;
- - sustainable development and improved diversity for research applications from space domain to industry areas and specific to national aerospace industry, increased education, security and social applications.
- Based on the long term visions of the project, Active Micro-Shields Systems will have a great impact on the space debris safety improvements, at all levels, and this will include aspects like, all space services, space safety and more important space business. The innovative method and concepts, will have a highly advanced performance well beyond current available standards or specifications, thus providing a wide range of research opportunities for the EU space industry and national aerospace industry with impact into engaging in advanced space services, and travels beyond earth's orbit, both of which can impose significant space safety limitations with regard to the future long-duration explorations for any kind of space missions.
- This project is expected to open new avenues of space research and technology, enhancing the relations with established international space powers as regarding the added value to the European space activities. Present project will also encourage the SMEs community which could potentially enhance the innovative impact of this proposal and could take as good practice example the regional strengthening of research alliances for space technology based on public-private partnership. This proposal will have an impact by reducing the vulnerability of space infrastructure assets, and the effect of on-orbit collisions with medium to very small particles.
- Therefore, the Active Micro-Shields© Method and System is addressing very well the actual space research objectives of STAR 2012, regarding the multidisciplinary and interdisciplinary scientific research, and well beyond the actual challenges topics and objectives, is toward the Vision 2025 and the ESA Agenda 2015.

- Dissemination activities
- **Participation in ESA programs**, Space European Technologic Platforms, Industry Group/Clusters:
- The project partners will have to enrol in any relevant ESA programs, Space European Technologic Platforms of the specific space industry group and clusters, promoting such activities related to the exploitation of the project results and by doing so, the final space product will have a much higher visibility and access to world markets, while it would be combined also with relevant products provided by related domains and by industry partners. ESA PROBA III and NEOSAT were identified.
- **Exploitation activities**
- The proposed activities are the background of the plans for exploitation and by dissemination of the project results, are devoted to exploit the innovation potential of this research project, disseminate the project and its achievements.
- The overall goal is to translate the scientific knowledge and space technology produced by this research project into space products and services will find their places in the space transport industry and regional development. To this end a group of activities addressing the exploitation potential of this research project have been selected, that can be largely categorized as:
- all the activities directly oriented to promote the exploitation of results: the objectives being to identify and analyse all factors that will influence the exploitation of results and also to build the necessary mechanisms for transfer of knowledge and technology produced to key research, industrial, economic, SMEs and policy stakeholders in order to accelerate their entrance into the market.
- dissemination of activities beyond the project's consortium: the objectives are raising awareness of space community the knowledge and technology produced by this research project along with its implications both economic and social, through publications, conferences, workshops and web-based activities under development.
- **Technology Transfer and Commercialisation**: will be done exclusive by EBIC using strategic plans for converting the knowledge and technologies produced into products and future new SMEs services by:
- - Analysis of different technology transfer mechanisms/law/tools best suited to the technology produced.
- - Formulation and implementation of technology brokerage activities in frame of workshops/conferences.
- - Analysis of the market & business implications of the project: how the results of this project will impact the space industry, assessment of commercial trends for technology developments at national or EU levels.
- - Formulation of business and commercialization plan that will be updated by EBIC in cooperation with IMT.
- - Study of the IPR issues impacting the project results will be made by EBIC and IMT during this project.
- EBIC has the ownership regarding the IPRs for the Micro-Shields System, the IPRs for the embedded micro- and nano-technologies are own by IMT, since both of organizations were partners in that ESA SURE AO 2006 project proposal, and since then both have developed the whole system, therefore, all dissemination about project results will must take into account this reality.

- Conclusions:
- The Active Micro-Shields© Systems is designated for protection of human and autonomous space systems, is a radical innovation research with simple solutions embedded in the micro- and nano-technologies, which will lead to other future "disruptive technologies", such as new detectors for monitoring of the space micro-particles, energy capacitors and storage, composite materials, nano-electronic devices, electronic shield systems, etc., system will include the advanced nano and micro-technologies which enable far-reaching space activities, based on the extended hardware's life-cycle, support for the typical challenges already identified as key issues for the permanence of human presence in space: safer space stations with longer life-cycle, reducing subsystem failures, improved space electronics, sensors, detectors, on-board computers, etc.