space meets manufacturing

Startup competition – industry challenges

SPACE MEETS MANUFACTURING

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SBIC
space business innovation centre
Noordwijk

Challenge #1 by ArcelorMittal – Predictive tool for weldability

Challenge title	Predictive tool for weldability (operational & technical weldability of C-Mn steels)	
Challenge description	Development of a predictive tool that quantifies both operational weldability (the likelihood of producing acceptable welds without critical defects) and technical weldability (properties of the weld zone after the thermal cycle: hardness, toughness, phase composition) for (C-Mn) steels and provides process parameter recommendations.	
Why is this challenge a problem or opportunity?	**Problem**: It is currently very difficult to reliably predict whether a weld will be defect-free and what the mechanical properties in the heat-affected zone will be. Misjudgements lead to scrap, rework, project delays and safety risks.	
	Current situation: Traditional approaches (carbon equivalent values, Schaeffler/DeLong diagrams, CCT diagrams, t8/5 estimates) provide only limited guidance. Many influencing factors (composition, microstructure, energy input, cooling cycle, weld geometry, filler material, precipitation, O/N content) interact in complex ways.	
	Request for solution: A practical tool that integrates multiple influencing factors and provides: (a) risk/probability of defects, (b) predicted mechanical properties in the heat-affected zone, (c) recommended process parameters with uncertainty estimates.	
What have you tried before?	Use of traditional heuristics such as carbon equivalent, Schaeffler/DeLong, CCT diagrams, t8/5 estimates. Empirical/rule-based decisions by welding experts. Occasional thermal simulations or simplified FEA for cooling time estimation.	
Expectations about the solution & impact	**Functionality**: physics-based + data-driven models; inputs: composition, microstructure descriptors, process parameters, geometry, filler, sensor data; outputs: defect risk, mechanical property predictions, recommendations, uncertainty margins. **Impact**: fewer trial-and-error welds, faster development of new materials, reduced costs from scrap/testing, higher reliability, shorter time-to-market.	
Implementation roadmap	1. Define scope & success metrics. 2. Collect and standardise welding data, metallographic characterisation, testing, process logs. 3. Develop physical base models (thermal FEA, phase transformation, precipitation kinetics). 4. Build hybrid/data-driven layer (physics-informed ML or surrogate models). Validate with laboratory welding and mechanical testing. 5. Develop UI/API and integration into CAD/PLM/process tools. 6. Pilot projects with industrial components, then scale up.	
Other relevant information	Requires well-labelled datasets; destructive testing for labels can be costly. Standardised testing methods (ISO/EN) recommended for comparability. Risks: limited data for rare steel grades; high process variability; regulatory demands for safety-critical applications. Collaboration needed: material scientists, welding engineers, manufacturers, software/ML partners.	

Challenge #2 by ArcelorMittal – Multi-purpose structural optimisation tool

Challenge title	Multi-purpose structural optimisation tool (multi-objective structural optimization, CAD + materials + manufacturing constraints)
Challenge description	Development of a software solution that couples parametric CAD models with automated FEA and multi-objective optimisation (e.g., stiffness vs. weight, payload vs. cost), including material selection and manufacturing constraints, to generate manufacturable design alternatives systematically.
Why is this challenge a problem or opportunity?	**Problem**: Optimisation today is often manual, iterative and based on engineering judgment; this consumes time and may overlook better solutions. Trade-offs are often suboptimal.
	Current situation: FEA is well established but mainly used for checking individual designs. Parametric variations and material choices are often considered separately. Topology optimization exists but is not well integrated with materials, costs or manufacturability.
	Request for solution: A software tool that automates CAD parameter variations, runs FEA, evaluates multiple objectives and outputs manufacturable, cost-estimated design options.
What have you tried before?	Manual parameter variation combined with FEA. Standalone topology optimisation tools, often without automated material/cost integration. Engineering heuristics for design decisions.
Expectations about the solution & impact	**Functionality**: accepts parametric CAD models, automates meshing/FEA, performs multi-objective optimisation (Pareto-front), considers manufacturing constraints, exports manufacturable CAD designs and BOM. **Impact**: shorter design cycles, optimized weight/cost performance, stronger decision support, fewer manual iterations.
Implementation roadmap	1. Define requirements, objectives and constraints. 2. Integrate parametric CAD workflows. 3. Automate FEA pipeline (meshing, solver, batch runs). Develop optimisation engine (genetic algorithms, surrogate models, topology optimization). 4. Add material & cost module with databases and manufacturability rules. 5. Build visualisation and decision-support tools (Pareto-front, sensitivity analysis). 6. Validate by prototyping and testing optimised designs.
Other relevant information	Requires sufficient computational resources; robust meshing strategies. Manufacturability constraints are crucial to avoid impractical designs. User adoption depends on transparent trade-off visualisation. Surrogate models may reduce computational load in large parameter spaces. Collaboration with manufacturing experts required for realistic constraints and cost models.

Challenge #3 by ESA – Non-destructive inspection (NDI) methods

Challenge title	Lead time and costs of Non-Destructive Inspection (NDI) methods
Challenge description	Reduce cost and lead time of Non-Destructive Inspection (NDI) for (large-series) spacecraft manufacturing.
Why is this challenge a problem or opportunity?	**Problem**: NDI methods are crucial for Space Industry to assure the health and reliability of the satellite systems but need a lot of time and manual labour as they are not automated as in other industries. Especially for NEW SPACE and big constellation projects this is a huge problem.
	Current situation: Hardly any in-line NDI methods are used in Space Industry. Most NDI is applied by an operator after the manufacturing of the part, which is costly in terms of money and time.
	Request for solution: Introduce state-of-the-art NDI approaches and technologies from large-series-manufacturing industrial sectors.
What have you tried before?	Standardisation through ECSS. Communality for certain subsytems (e.g. Gyroscope, Startracker, Suntracker) operating in different Earth orbits.
Expectations about the solution & impact	Satellites would be manufactured faster. Significant cost reduction → affordable for NEW SPACE missions

Challenge #4 by ESA – Serial production technologies for hardware and (space) electronics

Challenge title	Fast, low-cost and reliable manufacturing of space electronics hardware
Challenge description	Reduce cost and lead time for space electronics Hardware, to support trend towards larger series commercial spacecraft.
Why is this challenge a problem or opportunity?	**Problem**: Design of electronics hardware is mission specific and therefore small series compared to other industries are manufactured often with a high percentage of manual labour. The hardware has to survive the harsh space environment, with other threads than on earth environment (e.g. radiation) and therefore a high amount of inspections are needed.
	Current situation: Lead time is too long and cost too high for constellation projects and NEW SPACE missions (small satellites, Cubesats,..)
	Request for solution: Introduce state-of-the-art commercial technologies from non-space electronics materials and processes, into high-reliability space electronics hardware.
What have you tried before?	Standardisation through ECSS. Communality for certain subsytems (e.g. Gyroscope, Startracker, Suntracker) operating in different earth orbits.
Expectations about the solution & impact	Satellites would be manufactured faster. Significant cost reduction → affordable for NEW SPACE missions
Implementation roadmap	Introduce know-how in production methods from large-series-manufacturing. Improve the reliability and efficiency of inspection methods for electronics assembly and enhance the operators' training practices
Other relevant information	Potential technology areas (non-exhaustive): lead- free assembly, Printed Circuit Board technologies

Challenge #5 by Technoport/ESRIC – Space Resource Utilization (SRU)

Challenge title	Bridging terrestrial technologies to space resources applications
Challenge description	Advance Space Resource Utilization (SRU) capabilities with space grade prospecting, extraction and manufacturing solutions Applicants are invited to build on existing terrestrial and space solutions that can be adapted for SRU operations.
Why is this challenge a problem or opportunity?	**Problem**: The challenge addresses the problem of reliably locating, extracting, and converting offworld resources into usable materials and products in extreme space environments.
	Current situation: While various terrestrial and space technologies exist for sensing, robotics, excavation and manufacturing, there is no fully integrated, reliable and scalable system for utilising offworld resources. Current SRU efforts are largely experimental, limited to prototypes or laboratory demonstrations and face challenges in autonomy, extreme environment operations, resource processing and closed-loop system management.
	Request for solution: Robust technologies and approaches that enable end-to-end Space Resource Utilization (SRU), including autonomous prospecting, efficient extraction, and in-situ manufacturing of materials such as oxygen, water, propellants, and construction resources, suitable for extreme space environments.
What have you tried before?	Ongoing investigations: Autonomous platforms, laser spectroscopy, solar concentration, bulk handling, connectivity
Expectations about the solution & impact	**Prospecting:** Sensing, mapping and characterisation of resources; autonomous survey workflows; data fusion and decision support. **Extraction:** Excavation, beneficiation and material handling in extreme environments; closed-loop fluid and dust management; reliability-by-design. **Manufacturing:** SRU-enabled production (e.g., oxygen, water, propellants, construction materials, metals/polymers); process control, in-line QA/QC, and modular plant design.
Implementation roadmap	Testing from earth DTVC (Dusty Thermal Vacuum Chamber) to space in the next 5+yrs.
Other relevant information	It is recommended to explore previously supported initiatives under the ESRIC Startup Support Program.

Ready to answer your questions!

EIT Manufacturing
Silvia Grätz
silvia.graetz@eitmanufacturing.eu

NL Space Campus
Maaike Smelter
m.smelter@nlspacecampus.eu