New application of nanotechnologies and microtechnologies for more efficiency and environmental effects in European manufacturing industry

The European innovation project »ReSiSTant« that started on January 1st 2018 with a term of four years aims at optimizing two industrial pilot lines by using micro- and nanostructured surfaces for drag reduction. The objectives are to implement new developed surfaces into 1) Aircraft Turbofan Engines and 2) Industrial Compressors. Positive effects by usage of such surface could give benefits in terms of efficiency, CO_2 reduction and noise emission and further on a positive economic and ecological impact.

Despite the effectiveness of the riblets as passive devices for drag reduction being undoubted, and the mechanism for which this happens having been clearly demonstrated for a couple of decades, a verification of this capability has not been proven to date in full detail, due to the difficulties of the experiments, the lack of the numerical models and mainly the appropriate materials.

To enable the usage of such micro- and nanostructures, special development on the surface material for better durability in rough conditions has to be done. It is planned to do nano-functionalization, like implementing nanostructures and nanoparticles for better resistance in rough conditions. Riblets basically consist of tiny streamwise grooved surfaces which reduce the drag in the turbulent boundary layer of up to 8%. Surface modifications such as riblets are the most promising technology that could be applied without additional external energy or additional amount of air.

The project aims at developing innovative manufacturing technologies by implementing nanostructures and nanoparticles and it will be assured by two demonstrator lines. During this project, the main efforts for technology advancement will be dedicated to 1) the demonstration of production of large scale high ReSiSTant nano- and microstructured surface on two demonstrators 2) the combination of different process technologies and steps in order to demonstrate the complete fabrication chain for the two selected application demonstrators, and 3) setting-up of an industrial demonstrator in two different fields (industrial compressors and aircraft turbofans).

Application of nano and micro technology to demonstrate its potential for future market application

ReSiSTant project can be considered a "Demonstration-to-Market" cross-sectorial project (turbomachinery – nanotechnologies – manufacturing process) which will leverage unique knowledge from partners (IFAM, BST, NCT) in the field of fluid-dynamics and nanotechnologies towards a robust industrial exploitation of project outcomes driven by motivated stakeholders present in the consortium (LHT, MAN, GEDE) which are global EU key players in their sectors. In addition, RTWH will provide its knowledge on radial compressor testing in order to lead rig design and testing for demonstrator 1 while TU Graz, expert in the field of gas turbines especially for aero engines, will lead rig design and testing for demonstrator 2.

All the knowledge generated from the implementation, demonstration and monitoring will be further exploited for the definition of the up-scale design of full scale manufacturing line paving the ground towards replication across the EU and a technology roadmap will be setup also considering standardization and safety aspects (IDON, RINA) towards the marketability of the outcomes within 2025. The project results will be promoted through a powerful dissemination strategy in order to foster a rapid market deployment and a widespread replication in other European contexts. Particular attention will also be devoted to exploitation of Intellectual property derived from the project.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 760941

Figure 1 gives an overview about the main goals of ReSiSTant as well as the work packages.

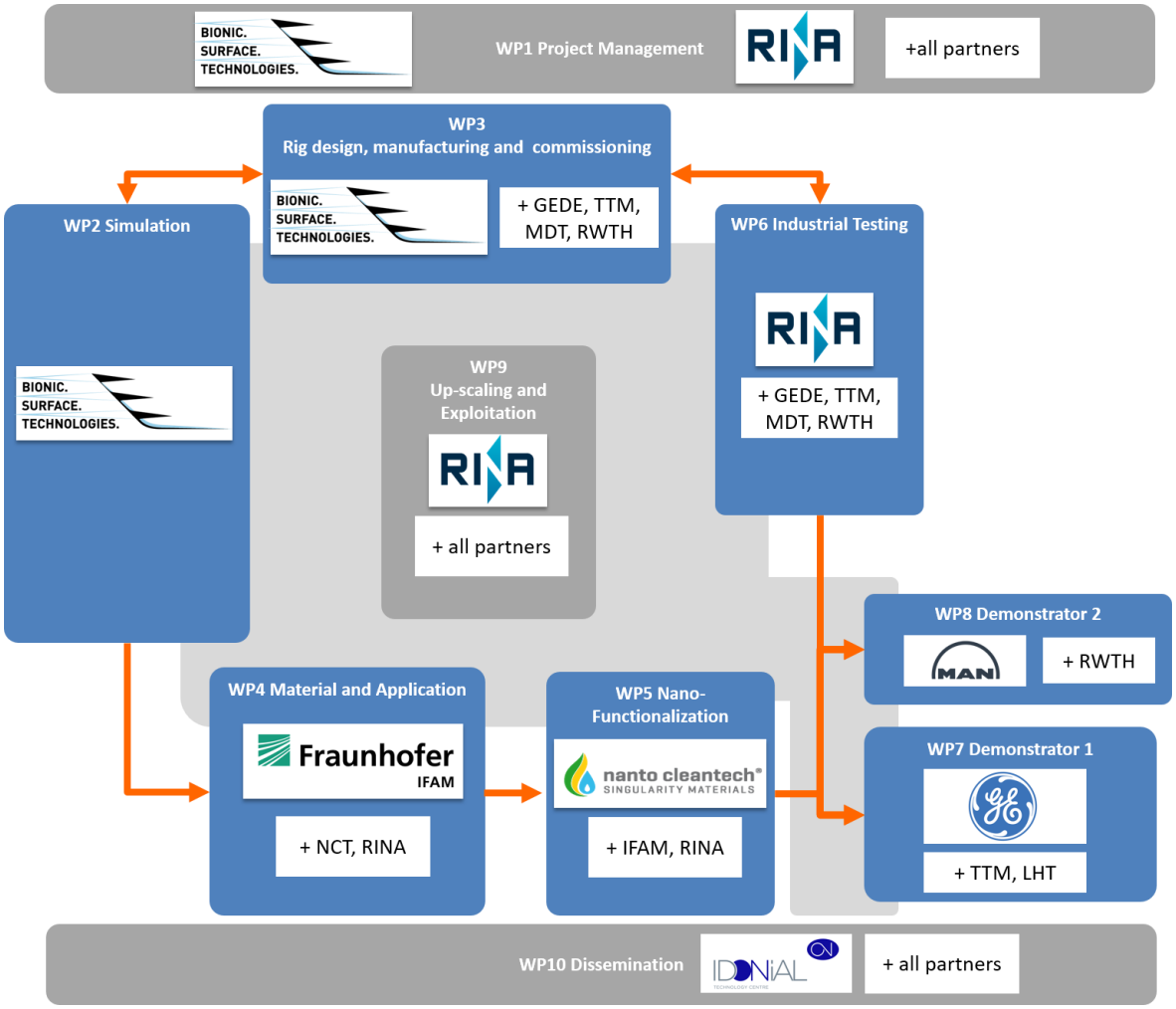

Figure 1: ReSiSTant methodology

Demonstration in two real industrial pilot lines

The project has defined two pilots where testing the technological developments. Both Pilots are directly embedded into the product portfolio of three globally acting enterprises from the consortium. One of them MAN Energy Solutions (MAN ES) is a world market leader in the field of industrial compressors. GE Aviation (GEDE) is one of the leading companies worldwide developing and researching high efficient jet turbines. Last one is Lufthansa Technik AG (LTH), a world leading aircraft MRO (Maintenance, Repair and Overhaul) company which covers the aftermarket and retrofit market of in the project developed ideas. Figure 2 shows the target parts for each demonstrator. The pilot lines will be also optimized by implementing ICT technologies to improve production efficiency.

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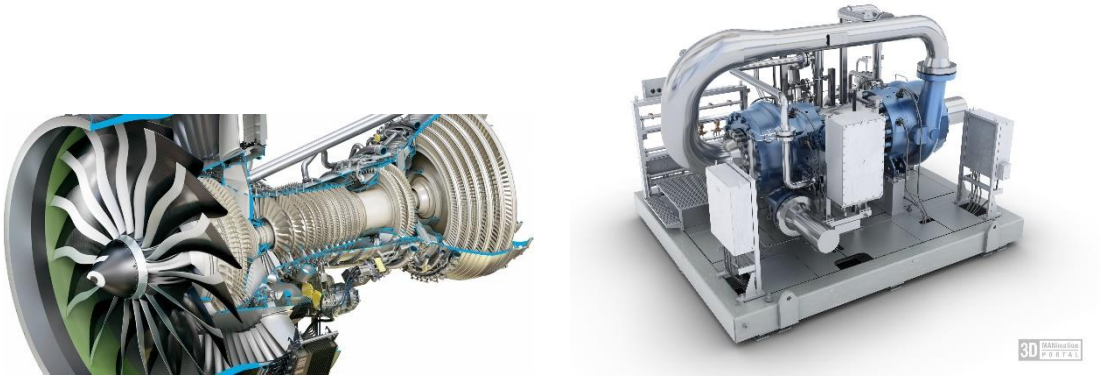

Figure 2: Target parts to be treated on demonstrators (left: Demo 1 and right: Demo 2)

Consortium:

BIONIC SURFACE TECHNOLOGIES GMBH (BST)	Austria
RINA CONSULTING SPA (RINA)	Italy
FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNGM E.V. (IFAM)	Germany
FUNDACION IDONIAL (IDON)	Spain
GENERAL ELECTRIC DEUTSCHLAND HOLDING GMBH (GEDE)	Germany
LUFTHANSA TECHNIK AKTIENGESELLSCHAFT (LTH)	Germany
MAN ENERGY SOLUTIONS SWITERLAND LTD. (MAN ES)	Switzerland
NANTO CLEANTECH IS (NCT)	Israel
RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN (RWTH)	Germany
TECHNISCHE UNIVERSITAET GRAZ (TU Graz)	Austria

10 partners from 6 countries representing key stakeholders such as industry, research centres, universities…

The multi-disciplinary project consortium consists of 10 partners from Austria, Germany, Israel, Italy, Spain and Switzerland. The project partners have large, internationally acknowledged experience and reputation in the fields of research and manufacturing required by the project: FEM and structural analysis, LCA analysis, HSE and Risk assessment; innovation management; CFD simulations; design and testing of laboratory and wind tunnel experiments; test articles and riblet manufacturing; materials science and related manufacturing nanotechnologies. This combination of partners, working together, is bringing the needed experimental, analytical, modelling and dissemination skills required for successful delivery of the project work plan.

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