NAVIN
IRC

Nano Science & Technology for
Advanced Aerospace Vehicles in India

THE "NAVIN" CONSORTIUM

Emerging Nanotechnology based Materials, Sensors and Systems Applied to Future Missions and Economies

LED BY

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BACKGROUND & RAISON D'ÊTRE

Many new micro-nanotechnologies (MNT) based materials, sensors and system concepts fall in the regime of technology push, which is that there is generally no high-TRL system-level application that is driving their development. However, once infused into or implemented within a specific mission, they promise to enable exciting, breakthrough applications that were previously not possible, nor envisioned.

In order to reap the potential of emerging MNT concepts and increase the number of these concepts that are successfully implemented in system-level applications, CANEUS International has been an early pioneer in proposing and applying collaborative solutions for overcoming the so-called mid-TRL (Technology Readiness Level) "valley of death" and thereby smoothly transitioning MNT concepts to aerospace applications.

CANEUS International, a non-profit organization, proposes a rapid and cost-effective method of technology transition via the creation of international collaborative consortia. Especially important is the creation of international partnerships between industry, university, and government stakeholders to pool resources and create smoothly functioning development "pipelines" with the necessary industry "pull" for emerging technology concepts. To date, CANEUS International has created and currently coordinates five Sector Consortia dedicated to Nano Materials and Sensors, Nano-Satellites, Nano Devices and Instruments, Fly-by-Wireless, and MNT Reliability.
The Centre for Nano Science and Engineering (CeNSE) has unmatched facilities in India for research and development work in micro and nanotechnologies. The CeNSE has invested approximately US$200 million (in PPP terms) and houses world-class facilities for nanofabrication and device characterization. The CeNSE also has ambitious outreach programs that include more than 150 universities of India and all major national labs in addition to several companies. The CeNSE enjoys support from all major funding agencies in India. The CeNSE is the heading a large initiative on sensor development for the aerospace industry. Therefore, it is apt to establish the proposed CANEUS led IRC at the CeNSE and use it as a nodal point for initiating and expanding collaborative projects and programs with all stakeholders in MNT for Aerospace applications.

CHARTER OF THE "NAVIN" CONSORTIUM"

The CANEUS MNT for Advanced Aerospace Vehicles in India "NAVIN" Consortium is envisioned as an international forum promoting the advancement of a broad range of emerging nanotechnologies for use by the global aerospace industry. The "NAVIN" Consortium aims to include all the primary industry stakeholders, including technology developers, system integrators, and aerospace end-users.

The "NAVIN" Consortium will be the steward of the aerospace industry's strategic and technology roadmap for emerging nanotechnologies. In keeping with the CANEUS International philosophy, it aims to establish a collaborative environment wherein resources from partner organizations are pooled to focus on high priority initiatives aimed at accelerating the infusion of emerging nanotechnologies into aerospace applications.
The "NAVIN" Consortium also acts as the facilitator for finding applications for the exciting new intellectual property jointly developed through academia-industry collaboration as well as the development of the appropriate supply chain organizations.

The NAVIN Vision

"To increase economic benefits to its members (profits, grants, jobs, etc.) through the development and use of new and innovative micro- and nano-technologies."

NAVIN CONSORTIUM OBJECTIVES

"The Consortium is targeted to foster collaboration between industry, academia and government partners, focused on pre-competitive projects to work towards goals set by all, for the research, development and experimental validation of emerging nanotechnologies and concepts to contribute to the advancement of the aerospace industry as a whole while retaining competitiveness in the market".

IMPLEMENTATION MECHANISM: IRC

The Industrial Research Chair - IRC is the key mechanism to accomplish the NAVIN Consortium goals.

The industry would like to ensure the NAVIN consortium to invest their money in and to have a clear mechanism for their participation and influence in the decisions on which projects would be promoted.

Therefore, with oversight from industry, the IRC will define and implement a robust research and development program to meet these identified needs.

The IRC could also be the logical facilitator for moving a project to a competitive mode by choosing or advocating appropriate partners for a joint venture or licensing agreement.

The IRC will further benefit from partnership with IRC partners from Canada, USA, Europe, Japan and elsewhere. For example, proposed partner Institutes from Canada include: the Canada Excellence Chair at the University of Alberta and the Canada-India Centre of Excellence at Carleton University.

Proposed IRC Focus Areas:

A. Commercial Aircraft

Today's commercial airplane business is characterized by huge global demand and consequent aircraft backorders that stretch over several years. In some cases these long delays in delivery can inhibit the best marketing strategies.

Rather than increase factory capacity and take on the associated capital and tax burdens, manufacturers desire shorter, fewer process steps, more efficient rapid inspection technology, and leaner process controls and corrections. These kinds of cycle time improvements cannot be wrung from existing technologies; their success must rely on new and advanced materials and processes. MNT shows great promise for significantly increasing the production rate desired by manufacturers.

B. Production rate increases

Using new nano-enhanced materials and processes technologies would make production of commercial airplanes from small components to large structures and assemblies faster and more efficient, while maintaining or improving quality and costs, will be a major theme in this consortium.

Some examples of opportunity-rich development are faster and tailor-able cures of composites involving new nano enhanced polymer formulations and leaner out-of-autoclave processes, faster materials laydown and incorporation with materials enhanced to have longer outimes and handling lives, multifunctional materials that eliminate secondary and tertiary functional materials and application times, 3-D printing of major components, etc. Often improvements in efficiency and reduced cycle times carry ancillary benefits in decreased pollutants as well as reduced raw materials storage, thereby reducing costs as well as bringing in a greener, leaner, and faster production environment.

C. Environmental Cleaner Products

Composite materials and new innovative approaches all help reduce fuel consumption and reduce greenhouse gas emissions while improving the environmental performance of the aerospace industryNT for Integrated Sustainment of Aerospace Vehicles:

D. NT for Integrated Sustainment of Aerospace Vehicles:

A key discussion thrust will identify and infuse emerging novel, nano-enabled materials, coatings and sensor technologies for the development of new as well as sustainment of existing aerospace vehicles. Research & development efforts are underway to develop solutions to extend vehicle life; reduce repair, maintenance and overhaul; cut fuel consumption and overall costs. Potential solutions include: development of new and improved materials, surface treatment (coatings), repair technologies, Prognostics & Health Management (PHM), and Additive Manufacturing (AM), as well as issues related to technology insertion, certification and implementation.

The key challenges include: transitioning these technology concepts from the system development and acquisition world to the sustainment world, and how the best industry-tested practices can be moved into the end-user applications. The industry vision for the future is to move from the current paradigm in which research and development leads sequentially through materials/component design, component testing, certification/qualification, manufacturing, and sustainment—to an integrated sustainment paradigm in which all these stages in the life cycle are being examined interactively and in parallel.

It is our hope that the NAVIN Consortium will propose a multi-phase approach to build on these efforts to develop a common platform that has crosscutting benefits for improving fleet maintenance and sustainment, with promising returns on investments..

E. Space Vehicles

In order to successfully develop innovative space vehicles and systems and undertake long duration missions, conventional materials need to be improved with regard to performance by several orders of magnitude, a task difficult to achieve using current technologies. New concepts and approaches are required to design, develop, and fabricate materials with multiple capabilities including strength (stiffness and toughness), sensing/actuating, and self-healing while yet having a multi-functional aspect for savings in cost, size, mass and power.

F. Space Exploration

Space exploration in the 21st century will be far more complex, of longer duration and with significantly more challenging objectives than the missions of the 20th century. Therefore, new

technologies have to be developed in order to enable 21st century space missions, covering all aspects of design, build, assembly, testing, launch and sustainment of these challenging missions. MNT stands poised to capture large sectors of this very exciting market with impacts in materials, devices, structures and systems for space exploration.

G. Naval Vehicles

It is envisioned the naval vehicles will benefit in many applications areas that take advantage of the emerging nanomaterials and sensors, e.g. nanostructured coatings for greater lifetimes; scattering of multiple phonon frequencies providing enhanced thermal management materials and thermoelectric devices; reduced diffusion distances in electrodes and cell architectures enabling simultaneous increases in battery power and energy densities; high surface area particles for sensing and novel catalyst applications; and, enhanced electron transport in nanowire composites providing potential for controlled dielectric constants.

For example, several Indian companies have successfully entered the naval shipbuilding arena and have undertaken major initiatives to acquire state-of-art-technology for naval systems and sensors.

VALUE PROPOSITION OF THE NAVIN CONSORTIUM TO INDUSTRY

Close collaborations with CANEUS Consortium Industry partners ensures that the concepts being developed by the NAVIN Consortium IRC will eventually find a home in system-level applications being pursued by the industry sponsor. The NAVIN CONSORTIUM IRC will further bring about tremendous economic benefit to the region by spurring the growth of small and medium-sized enterprises centered on the CeNSE hub and the large end-users supporting it.

Benefits to industry partners include:

- Opportunity to direct early stage R&D towards future aerospace goals.
- Opportunity to develop a robust “ecosystem” consisting of early TRL R&D, Mid TRL SMEs part of the industry supply chain and High TRL transition to own manufacturing and system integration.
- Demonstrate the deep impact of ongoing and planned investments into the development of academic institutions and SMEs for the aerospace supply chain within India.

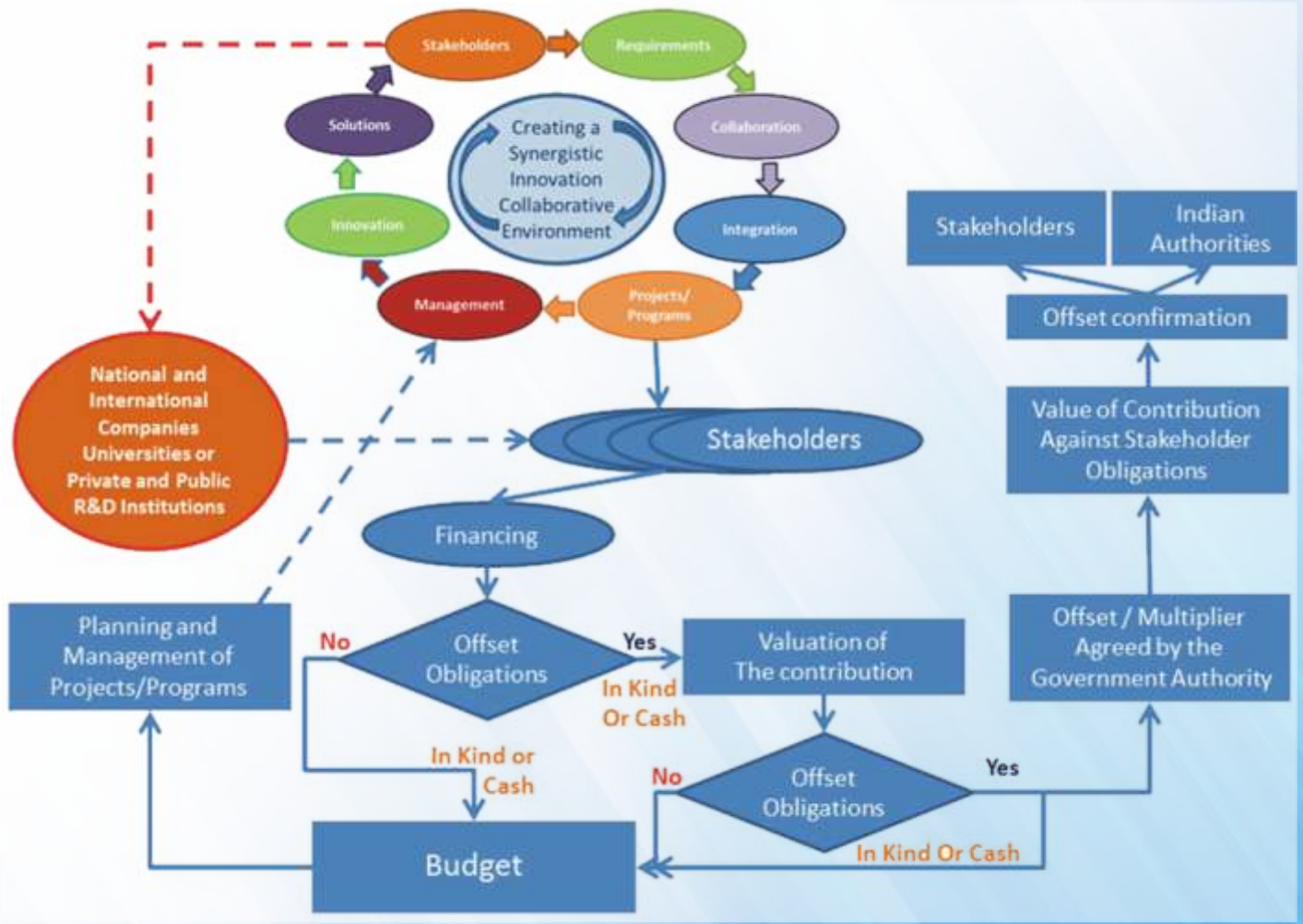
Additionally, partners are assured of the following benefits:

- Cost and risk mitigation: Access to jointly developed pre-competitive technology development
- Participation in collaborative technology, product and business development environments
- Licensing access to a fair and equitable IP-brokering service
- Reduced time-to-market and rapid system-level product deployment through supply chain development and collaboration
- Access to CANEUS forums/conferences as key networking platforms to address relevant issues
- Access to CANEUS’ global “technology portal” that identifies state-of-the-art nanotechnologies

Last but not least, the strong ties to India represent access to an extremely large and rapidly growing market for new products and systems within the Aerospace and Energy sectors. Through robust collaborations between CeNSE and its academic and industrial counterparts, the Consortium will be able to provide the industry partner a significant multiplier on the utilization of their Offset Benefits.

LEVERAGING OFFSETS

The vision is to increase economic benefits to its members (profits, grants, jobs, etc.) through the development and use of new and innovative micro- and nano-technologies. Therefore, the IRC projects(s) must stand alone on their merits and benefits to all partners, with "offsets" as added benefit".



The "Offset Enabled Innovation Acceleration" model would see member companies making investments in IRC projects. Those companies that have offset obligations would be able to apply their investments towards the satisfaction of these obligations. Only that part of the investment that was spent in India would qualify, according to the GOI policies. If the company with the offset investment were to be large and have several divisions, the investments from the other divisions would qualify equally for an offset credit. Large companies may choose to set up an investment fund internally for NAVIN Consortium to encourage their divisions to contribute to IRC projects, thereby leveraging the offset investment funds available.