

Rolls-Royce Corporation

response to

Request for Information on Proposed New Program: National Network for Manufacturing Innovation (NNMI)

Technologies with Broad Impact

1. What criteria should be used to select technology focus areas?
 - a. Focus areas should have potential for pervasiveness throughout industry and dual-use (commercial & military) applications. For Rolls-Royce, technologies of interest would be relevant to power systems for Aerospace, Energy, and Marine applications.
 - b. Technologies chosen should be close to commercialization and need industrial pull to bridge the TRL/MRL4 gap. They should not be speculative or targeted for 10 to 20 years in the future.
 - c. Focus areas should strongly oriented toward advanced manufacturing and should be technology intensive rather than manual-labor intensive
 - d. Technologies chosen should have strong industrial interest and immediate to near-term application, but are too expensive and/or complex for any one organization to develop on its own.

2. What technology focus areas that meet these criteria would you be willing to co-invest in?

Rolls-Royce would consider the following as potentially strong areas of interest:

 - a. Casting –innovative methods that address increasing complexity in features and reduced dimensional tolerances
 - b. Composites – low and high temperature materials, manufacturing methods, inspection methods, supply chain and standards development
 - c. Advanced / intelligent machining and fabrication methods – diffusion bonding / superplastic forming, cold / incremental forming, adaptive machining, on-machine validation and sentencing, controlled surface and edge finishing, etc.
 - d. Advanced metrology and sensors – rapid inspection methods, adaptive methods, non-contact methods, metrology / inspection in aggressive environments, miniaturized methods. Includes robust shop floor systems integration into process and quality control.
 - e. Digital/virtual manufacturing and modeling technology – a framework that can support any and all of the NNMI centers. Should also include human-factors and knowledge-based management.
 - f. Advanced joining and near-net shape technologies not covered by the Additive Manufacturing pilot network – especially solid-state methods such as friction-stir

welding, linear-friction welding, inertia welding, metal-injection molding, powder HIP, etc.

3. What measures could demonstrate that Institute technology activities assist U.S. manufacturing?
 - a. Creation of new technology spin-off companies – number and success-rate over a sustained period of time
 - b. US manufacturing firms who continue participation in Institute projects – number and total funding over a sustained period of time.
 - c. US manufacturing firms that decide to participate in Institute projects in the future – number and total funding over a sustained period of time. In other words, does the ‘tsunami chart’ showing member participation versus time keep growing?
 - d. Sustained and growing investment of industrial R&D funds and transfer of personnel to Institutes to support technology development and implementation
 - e. Transfer of skilled personnel from the Institutes to industry
 - f. Decrease in manufacturing costs resulting from advanced manufacturing technology implementation – metrics to include quality, lead-time, inventory, energy consumption for example
 - g. Number of projects taken through to a specified TRL/MRL gate/level

4. What measures could assess the performance and impact of Institutes?
 - a. Amount of time for insertion of new technologies and manufacturing methods into industry and the associated supply chain – has it decreased?
 - b. Amount of time to bridge the TRL/MRL 4 to 7 gap – has it decreased?
 - c. The number of technologies to successfully bridge the TRL/MRL 4 to 7 gap and be successfully deployed
 - d. Increase in percentage of components or products that employ these innovative manufacturing methods and materials. For example, a meaningful metric for Rolls-Royce would be the increase in number of gas turbine components that use new materials or are assembled using new manufacturing methods.
 - e. Time and cost metrics should be able to show that the Institutes provide an equal or better return than corporate efforts on their own.
 - f. Number of records of invention (ROIs) and patents granted

Institute Structure and Governance

5. What *business models* would be effective for the Institutes to manage business decisions?
 - a. A pre-competitive / collaborative environment for critical enabling technologies and supply chain development so as to increase the amount of information exchange and sharing. Topics would be decided upon by the industrial members.
 - b. An open access environment to tools / equipment / technology for either collaborative or directed programs. These can be fee-based in addition to a membership fee.

- c. Annual fee for participation, with sliding scale relative to size of enterprise and level of participation for industrial members.
 - d. Financial and business accountability to lie with Institute leadership and Executive Committee.
6. What *governance models* would be effective for the Institutes to manage governance decisions?
- a. An administrative headquarters to act as hub for a distributed and flexible organization focusing on aspects of a particular technology.
 - Full time staff to lead and manage the Institute and be accountable to members and to cost and schedule
 - b. An executive committee to act as the governing board, consisting of:
 - Permanent members from Institute management and administration
 - Rotating members, representatives from advisory boards
 - c. The executive committee should be impartial and not be unduly influenced by larger members that pay higher membership fees.
 - d. Separate advisory boards in place for guidance and oversight, representing
 - Industry – large, medium, and small enterprises
 - Educational – universities, technical colleges, training institutes
 - Non-profits – regional, state, and local economic development bodies, professional societies, and miscellaneous interests
7. What membership and participation structure would be effective for the Institutes, such as financial and intellectual property obligations, access and licensing?
- a. Tiered structure for annual fee for industry, based on level of participation in the Institute and the size of enterprise
 - b. Set fees for educational and non-profit participation
 - c. Priority access to equipment and expertise to dues-paying members
 - d. IP created non-competitively at the Institute to be license and royalty-free for members. IP to be offered for a negotiated fee to those outside of Institute to generate revenue
 - e. IP brought into the Institute by members to be protected without exception
 - Non-disclosure agreements to be in place well in advance of any collaboration
8. How should a network of Institutes optimally operate?
- a. Central Network headquarters to coordinate and set policies for common business and technology management activities at each Institute
 - IP and export offices, budgeting and finance, public relations and marketing, central meeting and collaboration space
 - b. Call for proposals and new member solicitation activities to come from each Institutes
 - c. A special Institute dedicated to enabling technologies that are pervasive the entire Network should be considered (ie, virtual manufacturing and modeling, human factors, advanced education and training concepts, etc.)

9. What measures could assess effectiveness of Network structure and governance?
 - a. Efficiency, cost, and speed by which new Institutes are proposed, initiated, built, and managed
 - b. Gradual reduction in amount and elimination of Federal Government support – do the Institutes within the Network truly become self-sustaining within the 5 year window?

Strategies for Sustainable Institute Operations

10. How should initial funding co-investments of the Federal government and others be organized by types and proportions?
 - a. Divide by funding needed to implement and sustain:
 - Overhead and infrastructure costs
 - Technical development / educational / training activities
 - b. Slowly phase out Federal funding over 5 years as a proportion of support until 100% driven by membership fees, directed program fees, education and training fees, and IP licensing / royalty fees
 - c. Even if success is validated using several metrics, the Institutes might need to continue to receive some percentage of Federal funding to sustain overhead and infrastructure. This should not be viewed necessarily as a demerit.
 11. What arrangements for co-investment proportions and types could help an Institute become self-sustaining?
 - a. Membership fees
 - b. Revenues from training and education, IP licensing and royalties
 - c. Create a 'sliding-scale' fee for members who are participating in more than one Manufacturing Network, rather than pay the full fee to be a member of 2, 3, or more networks.
 - d. Basic R&D work led by Universities should be welcomed if it supports 'the critical path' for bridging the TRL/MRL gap. Funding can be provided by other sources typically found in the academic setting.
 - e. Ensure that projects selected for technology development (collaborative and directed) have a high chance of success across the TRL/MRL 4-7 gap in order to entice sustained and increased membership enrollment.
 12. What measures could assess progress of an Institute towards being self-sustaining?
 - a. Basic financial metrics – revenues, profit / loss
 - Revenues should increase over time as the number of members increase and revenue-creating items are generated.
 - b. Increase in membership and level of active participation
 - Number of common and directed technology development programs
 - Numbers of personnel in training and education programs
 - Numbers of trained personnel and students being hired by members to support technology adoption for production
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13. What actions or conditions could improve how Institute operations support domestic manufacturing facilities while maintaining consistency with our international obligations?
 - a. An embargo period or right of first-refusal to deploy technologies or know-how offshore, but may require consideration for large multi-national industrial members
 - b. Understand fully how US export control will affect the participation of foreign members (eg. affiliates of industrial partners, foreign universities and institutes)
 - The stated goal of operations with no export control restrictions for open access work could be very difficult. What does ‘proprietary’ mean in the sense of the Institute membership and rights?
 - An in-house export control office will be essential.

 14. How should Institutes engage other manufacturing related programs and networks?
 - a. The Institutes should actively engage external manufacturing and engineering professional societies and invite these to become full members at a reduced rate – Society of Mfg. Engineers, ASME, ASM International, etc. These will be important stakeholders as they typically have considerable experience in education and training, standards creation, etc.
 - b. Encourage and show preference for collaboration with other manufacturing networks as appropriate, either within NNMI or with external organizations
 - c. Very strong Institute leadership required to manage these relationships

 15. How should Institutes interact with state and local economic development authorities?
 - a. Development authorities should act as advocates for the network – tax incentives, infrastructure planning, networking resources, etc.
 - b. Co-invest as appropriate, especially in early stages of establishing an Institute. This could include investment in particular projects with an additional measure of business risk (but with potential high payoff)
 - c. These authorities should have an advisory, but non-voting, seat on the Executive Committee in order to remain impartial.

 16. What measures could assess Institute contributions to long term national security and competitiveness?
 - a. Number of new manufacturing jobs and new companies created incorporated in the United States
 - b. Number of jobs in-sourced into the US from overseas – especially jobs that were originally outsourced originally as ‘low-wage.’
 - In other words, successes from the Institutes demonstrate the advantages of ‘advanced and domestic manufacturing’ versus ‘cheap and foreign manufacturing.’
 - c. Number of new and advanced technologies successfully adopted by US-based industry
 - d. Does the formation and success of the Institute provide a lasting example and template for accelerating new and advanced technology?
 - e. As technologies issued from the Institutes mature and a robust supply chain is created and becomes self-sustaining, does that particular Institute eventually morph towards another technology or dissolve?
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Education and Workforce Development

17. How could Institutes support advanced manufacturing workforce development at all educational levels?
 - a. Provide internship and co-op programs for high-schools, technical colleges, and universities
 - b. Create and promote outreach programs to high schools to dispel the notion that manufacturing as a profession is ‘dangerous, dirty, and disappearing.’
 - c. Support continuing education programs for credit and professional certification.
 - d. Provide input to curricula for certification courses

 18. How could Institutes ensure that advanced manufacturing workforce development activities address industry needs?
 - a. Develop and provide training at all levels relevant to industry – from shop-floor technician to engineer
 - b. Utilize advances in human-factors understanding and sciences to develop optimized training programs for the shop floor level.
 - c. Understand and address where the gap lies between Industry need and ability / capability of the typical worker. Directly involve industry in the development and assessment of training and education programs.

 19. How could Institutes and the NNMI leverage and complement other education and workforce development programs?
 - a. Offer facilities for vocational training, student internships, and graduate student research
 - b. Participate in programs similar to ASM International “Teacher Camps” – educators spend a week at the Network participating in structured programs to align educational subject matter to “real-world” challenges

 20. What measures could assess Institute performance and impact on education and workforce development?
 - a. Percentage of students and skilled workers employed in advanced technologies as a result of Institute participation and training
 - b. Track the percentages still working in industry 5 and 10 years.
 - c. Track salaries relative to the low-wage / low-skill workforce

 21. How might institutes integrate R&D activities and education to best prepare the current and future workforce?
 - a. Coordinate with Federal funding agencies (NSF, DOE, DOD, etc) to provide grants for professors and students to pursue research at the Institute
 - b. Host sabbaticals for professors for greater understanding of the links between R&D and manufacturing
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- c. Create “innovation portals” to solicit new ideas and concepts from students, teachers, and professors. Fund small packages of work to demonstrate feasibility and facilitate contacts with Industrial partners / members for further development.



Rolls-Royce

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25 October 2012

Dr. Michael Schen / Mr. Prasad Gupte
National Institute of Standards and Technology
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Dear Dr. Schen and Mr. Gupte:

Rolls-Royce Corporation would like to offer the attached responses to the "Request for Information on Proposed New Program: National Network for Manufacturing Innovation (NNMI)." We are excited about the possibilities that the proposed national network would provide in advancing US manufacturing technology and competitiveness. Through our involvement with CCAM (Commonwealth Center for Advanced Manufacturing) in Virginia and with other global manufacturing research centers, Rolls-Royce understands first-hand the opportunities that such a partnership can provide to industry, academia, and the US government.

Two of our technical leaders in materials and manufacturing technologies, Dr. Ann Bolcavage and Dr. John Matlik, attended and participated in "Designing for Impact II: Workshop on Building the NNMI," held July 9 at Cuyahoga Community College. The attached responses reflect the input that was submitted at that time, as well as offer some new perspectives on the design and mission of the proposed NNMI.

If you have any technical questions, please contact Dr. Ann Bolcavage at (317) 230-5228.

Sincerely,

A handwritten signature in black ink, appearing to read 'Ann Bolcavage', with a long horizontal flourish extending to the right.

Dr. Ann Bolcavage
Chief, Materials - Capability Acquisition
Rolls-Royce Corporation

A handwritten signature in black ink, appearing to read 'Lisa J. Teague', with a stylized, cursive script.

Lisa J. Teague
Director, R&T Strategy
Rolls-Royce Corporation