SCRA Applied Research and Development is pleased to offer the following comments in regards to establishing an *Institute for Composites Manufacturing Innovation (ICMI)* to serve as a national hub for composites manufacturing excellence to provide competitive advantages and opportunities for United States (U.S.) manufacturing facilities and enterprises and encourage economic investment. The following comments are offered in response to the U.S. Department of Commerce, National Institute of Standards and Technology Request for Information on Proposed New Program: National Network for Manufacturing Innovation (NNMI).

Institute for Composites Manufacturing Innovation (ICMI)

Summary

Over the last thirty years composites have been the dominant emerging materials where high strength and low weight are critical. The volume and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. Modern composite materials constitute a significant proportion of the engineered materials market ranging from everyday products such as sporting goods to sophisticated niche applications in aerospace and electronics.

Composite use continues to expand across all industry sectors. The global composite products market was over $56 billion in 2011, according to Lucintel, and is expected to grow to over $78 billion by 2017. Data from the American Composites Manufacturing Association (ACMA) suggests that the U.S. has a 36% global market share consisting of over 3,000 domestic companies. U.S. composite manufacturers employ 125,000 people and impacted suppliers and manufacturers employ another 338,000 workers.

There is vast growth potential for composites in many markets as indicated by current market penetration:

Automotive	3.6 %
Construction	7 %
Aerospace	10 %
Wind Energy	38 %
Marine	68 %
	Lucintel, LLC April 2011

It is estimated there are over 30,000 potential product applications. Appealing growth rates make composites an attractive market for industry development. A number of countries recognize the growth potential and seek to become global leaders in composite technology development. This is evidenced by the establishment offshore composite research development centers (i.e. Advanced Manufacturing Research Center, Sheffield England; CFK Valley Stade, Germany; The Center for Thermoplastic Composites, the Netherlands). Developing countries such as Brazil, Russia, India and Abu Dubi are beginning to play a larger role in composites manufacturing. To maintain our position as global leader the U.S. must build on its strengths, leverage its unique research, innovation and workforce capabilities, and create an infrastructure for composite manufacturing innovation to ensure that the next generation

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of processes and products not only will be invented in the U.S., but scaled up, transitioned and manufactured in the U.S.

Composites technology has continued to mature, with significant strides across the scale from basic research to commercial application. The field stands poised to make further impact on our nation's economy. New approaches to manufacturing are required to reduce the cost of implementing advanced materials technologies. Innovative manufacturing processes will address the major cost drivers preventing more widespread use of composites, while at the same time providing an environment that maximizes the competitive advantages of the U.S. industrial base. Focus on the application of composites will create market pull on the various components across the composites industry.

To help fully realize the growth potential of the US composite industry in the years ahead, action is needed to overcome barriers and ensure the industry is equipped for success in the future. The composites industry has a divided structure which does not provide sufficient incentives for major investments in skills and technology. The structure of the industry consists of small and medium enterprises (SMEs), niche producers and large sector specific manufacturers such as aerospace. SMEs and niche producers individually face challenges in the form of large up-front costs required to develop capital intensive processes and qualify new products, as well as the traditional risks of developing products for potential markets.

Given this, four issues have been identified to be addressed:

> The industry's fragmented market structure is leading to a lack of coordination across sectors. As a result, most companies perceive themselves as belonging to an industry sector e.g. aerospace or automotive rather than being part of a wider composites industry. In addition, most companies are SMEs and, outside of those with aerospace as their specialty, many struggle to generate the critical mass needed to boost investment in cost effective, rapid manufacturing and other advances.
>
> Knowledge and technical transfer is also affected between companies and industry sectors by the industry's lack of cohesive structure. Measures are needed to strengthen and accelerate the sharing of ideas and technologies throughout our composite industry.
>
> The development of composites demands new skills at nearly all levels. Action is required to identify and deliver the right training and qualifications to meet skills gaps and address the specific needs of individual sectors using these cross-cutting technologies.
>
> To increase the sustainability of this industry, measures are needed to strengthen recycling processes and develop added-value applications for recycled advanced composite materials to satisfy end of life concerns. In addition, the U.S. must act to further commercialize and promote its capability to recycle advanced composite materials and drive work on the properties of sustainable composites.

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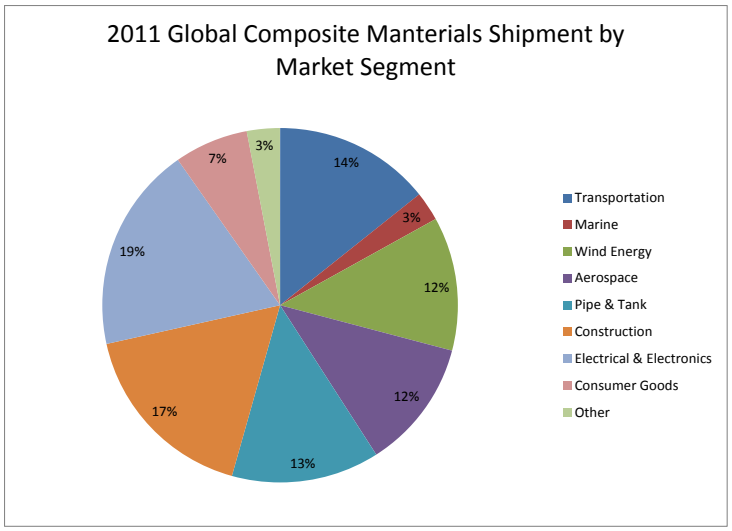
Establishment of an *Institute for Composites Manufacturing Innovation (ICMI)* under NNMI would provide a national composites approach focused on the application of innovations in the composite industry to reduce the cost of fabricating and implementing composites components, enhance competitiveness and encourage investment in the U.S. This will be a private-public partnership, wherein results will simultaneously advance technologies with wide applicability to the industrial base and result in demonstrations of products for specific partners who are ready for rapid transition to the market.

Background

On a basic level, composites are combinations of two materials: 1) a reinforcing material (fibers, fabrics, or particles); and 2) a matrix (organic, polymer, metal or ceramic matrix) material. Typically, reinforcing materials are strong with low densities while the matrix is usually a ductile, or tough, material, and binds the fibers together. Composites combine the strength of the reinforcement with the toughness of the matrix to achieve a combination of desirable properties not available in any single conventional material. Typically the primary driver and advantage in the adoption of composites is the lightweight properties combined with orthotropic tailorable properties. In transportation, lower weight equates to increased fuel savings and improved acceleration. In sporting equipment, lightweight composites allow for longer drives in golf, faster swings in tennis, and straighter shots in archery. While in wind energy, the lighter the turbine blade, the more power the turbine can produce. Besides weight savings, other significant benefits of composites include:

- Non-corrosive
- Tailorable conductive
- Dimensionally stable
- Low maintenance
- Long life
- Design flexibility

Composite properties make them ideal structures for use in a broad base of commercial and military applications including transportation (automotive, aerospace, light/heavy trucks), construction, electrical, filtration, ballistic protection, insulation and recreational.



The U.S. currently has a developed expertise in using composites in aerospace and high-performance military applications but there is a need to continuously improve in the increasingly competitive composites industry. Up to now activity has been too sector specific which has limited the development of a cohesive composites industry and the transfer of technology between sectors. There is a need to raise awareness of the commercial opportunities, as well as shape the technical and economic conditions necessary to develop rapid, cost effective manufacturing on a scale which has not been seen before.

The German automobile industry is developing next generation automobiles that capitalize on the pervasive benefits of composites. Auto manufacturers such as BMW, Mercedes and Volkswagen are establishing strategic alliances and development programs with leading composites providers to bring to market green, energy efficient and recyclable cars where everything you see other than the window, wheels and steering wheel are manufactured are composite; at a price that produces value to the consumer. The U.S. most adapt manufacturing models right sized for our culture to achieve the composites industry leadership position that we seek for both transportation, defense and commerial offering.

Laying the foundations now will allow for a skilled workforce equipped with the techniques and processes to produce high value goods such as aircraft structures, automotive components and wind turbine blades at greater volumes to a consistent standard. By laying these strong foundations the potential to increase and develop the use of advanced composites across other sectors is well within our grasp. The winners will not simply be our manufacturers, but also the supply chain which supports these companies as the industry expands and strengthens.

Challenges

While composites have already proven their worth as weight-saving materials, a current challenge is to make them more cost effective. The composites industry has begun to recognize that the commercial

applications of composites promise to offer much larger business opportunities than the aerospace sector due to the sheer size of transportation industry. Thus the shift of composite applications from aircraft to other commercial uses has become prominent in recent years.

Composites have found their place in the world and continue to gain market share, especially where performance is critical. However, new products, processes and markets continue to emerge and the demand for tough and lightweight composite structures is increasing. Despite these many benefits, there continue to be challenges to developing, manufacturing and deploying composites:

- Material and Processing Cost
- Part Fabrication Rates
- Certification & Non Destructive Inspection
- Interfaces with other Materials (Metals, Ceramics, Polymers)
- New Material Qualification
- Repair Technology
- End of Life Disposal and Recycling

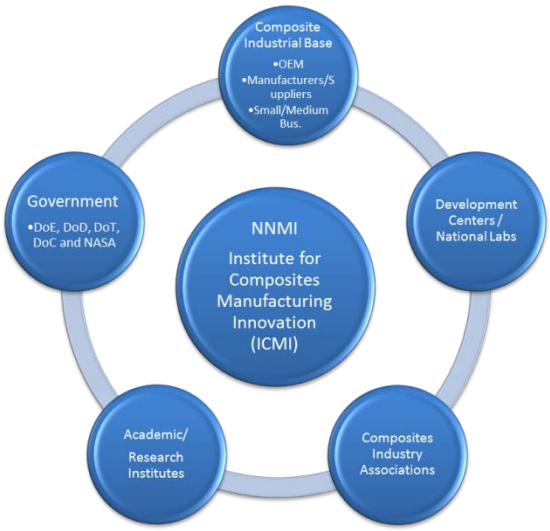
Strong developmental activities focusing primarily on products & processes will be pursued to establish the U.S. as a leader in this materials/manufacturing sector. Towards such an objective, a multi-disciplinary approach involving industry, academia, research laboratories, certification/standardization and user agencies will be required for a quantum jump in composite technology. Thus, key thrust areas may be summarized as:

- Near term & Far term research and development
- Application development
- Fabrication, Testing & Qualification support
- Availability & pricing of raw materials
- Manpower training
- Technical support services for materials & process selection, process optimization & design, product quality improvement etc.
- Standardization
- Technology Transition

Adaptation of automated technologies along with proper technical/training support will help achieve the improved quality & quantity of composite products. The establishment of an *Institute for Composites Manufacturing Innovation* will streamline development, enhance the speed and efficiency of more cost-effective production practices for U.S. composite producers, and increase the ability to compete on a global scale.

Institute for Composites Manufacturing Innovation (ICMI)

A strong model for an *Institute for Composites Manufacturing Innovation (ICMI)* will utilize distributed center management to best leverage existing commercial enterprises, academia, development centers and federal and state initiatives to develop fully tested products and sustainable solutions for the production of lightweight, low cost composite structures and components. An ICMI will enlist the nation's top academic composites researchers, industry experts, and the composites industry associations and their members to ensure relevant research and the rapid transition of results into U.S. industry. The overall goal is to enhance the competiveness of the U.S. composites industry through improved quality, cost efficiencies, successful transition to commercialization and reduced lead times. The U.S. composites industry will work in a cooperative environment to fairly distribute development opportunities and facilitate industry collaboration.



Benefits to the distributed center management model include low overhead cost, deferred amortization, and maximized development funding for the industrial base. This model has been successfully demonstrated in the management of the Office of Naval Research (ONR) Composites Manufacturing Technology Center (CMTC). CMTC forms integrated development teams from a consortium of companies that include composite industry suppliers, small businesses and academic institutions to address composite manufacturing challenges affecting components on naval platforms. The model provides for 92% of CMTC funding to be distributed to project teams for manufacturing development. Composite Manufacturing Development projects focus on implementing new materials, processes, capabilities and automation for cost effective manufacturing improvement. Improved process and equipment technologies implemented under CMTC have resulted in successful transfer of technology for substantial savings on Naval platforms including over $100 million on the F-35 Joint Strike Fighter and over $150 million on the Virginia Class Submarine. This established model for measuring performance improvements will be expanded to include measures for jobs creation and exports.

Structure

A successful institute will integrate public and private partnerships and combine commercial and academic research and development. It will extend the successes demonstrated by the CMTC utilizing a similar distributed center model, focusing on commercial applications, and widening the mission to include workforce development. An ICMI will need to build a national organization that spans all industry sectors (aerospace, automotive, energy and marine) in order to build a cohesive composites industry.

By leveraging existing infrastructure, development centers and National laboratories overhead cost are minimized, providing the maximum funding for industry and academic driven projects. Adoption of new technology would be accelerated via joint projects between start-ups, established manufacturing companies and universities. The aim is to support research institutions and business enterprises – especially small and medium-sized enterprises- in research, development and commercialization activities.

Technology Stewardship

A Technical Advisory Board , established to review all research proposals, select projects for funding and provide technical guidance, will include members from the government sponsors, and composites industry sectors (i.e. automotive, aerospace and marine) as well as members who represent material suppliers, fabricators, small businesses and academic institutions. Diversification of the technical board will ensure funding is fairly distributed to achieve maximum impact on the industrial base.

Manufacturing Innovation

The core focus of an ICMI is transitional research that bridges the gap between academic activity and industrial need. An ICMI will focus on developing manufacturing methods, test and inspection standards, validation data and training required to reduce the risk of transitioning research from laboratory to receptor industries and to reduce the cost of producing composite structures. Projects will address the pitfalls of new technology/products by generating validation test data, prototype funding, and qualification requirements. Funded projects are obligated to use research findings in the commercialization of marketable, innovative products, processes and services to strengthen the U.S. composites manufacturing industrial base.

Two main categories of projects are suggested; 1) projects which have broad applicability to the industrial base, and 2) projects focused on specific manufacturing or product development. This dual approach will widen participation in projects, increase research that will have broad applicability to the industrial base, and result in demonstration projects, successful technology transition and new product introductions.

Intellectual Property

An ICMI will manage collaboration as an honest broker, with the needs of the industrial base in mind. It is expected that projects will involve the pre-existing intellectual property of multiple partners. In order to encourage partners to bring these concepts into the ICMI for further refinement and development, strict protections for privately owned IP will be put into place.

The two thrusts of research projects will create IP that will be either broadly applicable to the industrial base or specifically applied to a developed application. IP which is narrowly applicable to company funded developed products will vest with that company. IP which is broader in application will be jointly owned by the participating partners and the ICMI and will be available to the US industrial base

Networking, Education and Workforce Development

Education and training of qualified personnel is one of the most important steps to develop and produce successful products; an ICMI network will partner with the existing nationwide Manufacturing Extension Partnerships (MEP) to leverage established MEP programs that reach into workforce development and technology transition. Additionally, an ICMI network will establish partnerships with other existing federal, state and local government initiatives working in Science, Technology, Engineering, and Mathematics (STEM) Education. These partnerships would include: Project Lead the Way (PLTW); National Science Foundation initiatives, NASA Education Student Programs among others.

Projects proposed to the ICMI will be required to address workforce development opportunities for partner organizations. These training opportunities will benefit the collaboration in the near term and the industry in the long run, maturing the skilled personnel to fill the jobs created by a growing market.

Sustainability

Initially, an ICMI would use government funding as seed money for new projects. Cost share would come from industrial partners in the form of access to capabilities and equipment. Funds input into the ICMI would come from participant contributions and licenses from generated IP. The goal will be to transition ICMI to a self-sustaining non-profit organization once revenue generation will support the transition.

Support of other NMMI Centers

An ICMI will leverage the capabilities of the NNMI network to identify cross cutting technologies for joint development projects. Composites are rarely used in standalone applications but are components in larger systems which may include materials such as metal and advanced polymers. Identifying manufacturing methods for joining, automation, inspection and testing systems will require the collaboration of NNMI centers. An ICMI will network with other NNMI centers to identify best practices and win themes for continuous improvement and growth of the industrial base.

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