National Center for Manufacturing Sciences

Enabling Digital Manufacturing:
A Strategy to Develop a National Innovation Network

Just as the electric power infrastructure was the key to a strong manufacturing base a century ago, a Digital Manufacturing infrastructure is critical to the future of American industry. Economic uncertainty and leaden growth have slowed innovation, but access to cutting edge tools such as high performance modeling and simulation provide a bold path forward, essentially transforming the way America builds.

The Opportunity

Of the approximately 300,000 manufacturers in the United States, over 95% are characterized as small and medium sized (SMMs). While millions of Americans are employed by much larger manufacturers such as Boeing or General Electric, SMMs provide more than twice as many jobs. National economic recovery and development is dependent on the revitalization of U.S. manufacturing, and the most efficient way to spur rapid growth is to intensely leverage what already exists.

One of America's greatest competitive assets is our high performance computing (HPC) modeling and simulation capabilities. This toolset has been steadily developed and utilized by government laboratories, universities, and large companies for years - contributing to the successful manufacture of countless innovations. If shared throughout the entire manufacturing base, America's global competitiveness will be greatly enhanced, particularly in desirable areas such as high-tech R&D manufacturing and modeling/simulation tools development.

Recent economic challenges have delayed job creation and R&D investment for many manufacturers. Large companies that once led the world in R&D investment are looking to SMMs for serial innovation within the supply chain. HPC is a transformative technology that must be elevated across the entire manufacturing ecosystem to empower simulation-based R&D, design, and manufacturing. Effectively leveraging these tools will transform U.S. manufacturers and their processes resulting in: accelerated development, mass customization, radical new products, lower-cost manufacturing and reduced off shoring.

The Strategy

NCMS proposes the development of a knowledge infrastructure which leverages the wealth of talent, ideas and facilities within our universities, national labs and industrial research centers to bring SMMs access to this desperately needed technology.

Focusing on product design, development and advanced manufacturing, this network will consist of numerous public-private sector collaborations called Predictive Innovation Centers (PIC). Access through a secure web-based portal will allow manufacturers of all sizes to experiment with HPC tools and optimize their own innovation processes – eliminating the heretofore insurmountable cost-up-front barrier that has kept so many SMMs from adopting HPC.

Four Levels of Engagement

The NCMS PIC strategy addresses the entire spectrum of needs within the manufacturing supply chain – from the small engineering shop stuck on 2D CAD software to the global supplier lacking the hardware to fully leverage its simulation tools. The NCMS PIC will be the bridge that links existing education efforts with higher end services, through a progressive set of tools and services that can benefit users at any level of need. The strategy will facilitate upward progression, so users can elevate to a self-sustaining M&S capability. This unique approach is accomplished by engaging customers at four distinct levels.

Educate: Create a low-risk environment for end users to learn about M&S through free/low cost access to interactive demos, and education.
Entice: Clarify the value of advanced modeling and simulation to end-users by providing entry-level evaluative solutions.
Engage: Provide end users more robust modeling and simulation capabilities for specific engineering problems via more sophisticated tools and collaborative engineering projects.
Elevate: Enable full integration and adoption of advanced modeling and simulation at the end user level by providing necessary services and resources.

SMM Engagement and Scalability

Successful implementation of a national network will require scalability, affordability, accessibility, and marketability. The primary means to accomplish these four criteria is to build a base of virtual tools and services to reach SMMs with these new technologies. Many SMMs have small engineering shops, perhaps 1-2 employees wearing multiple hats. Due to the cost of bringing resources in-house, the lack of available expertise, and the high learning curve, many have chosen to outsource M&S tasks. The PIC infrastructure will give entry-level customers access to simple tools that can provide the same service faster and more affordably.

In line with the PIC's educational mission, the strategy calls for development of various e-Learning materials, communication tools, and links enabling users to run applications and simulations remotely. Each physical PIC location will be a full-service center tied into the PIC "cloud," which users will access through an all-inclusive, secure web-based portal.

The Benefits

Economic Impacts

The scope of this challenge calls for a government wide approach, integrating the strategy and leveraging it with existing investments for sustained economic growth and job creation. While PICs will result in the creation of new jobs at the centers themselves, the true benefits extend much further. Every region, every state, every community is touched by manufacturing. As almost 300,000 SMMs begin to engage HPC, they will grow their existing customer base and expand into new sectors, creating direct, indirect and induced jobs across the nation. The stage is also set for impact beyond manufacturing. New technology companies and service vendors for the growing HPC infrastructure will provide even greater sustained job creation, further supporting and enhancing community, state and regional services and facilities.

Global Competitiveness

U.S. suppliers must be able to affordably leverage predictive simulation-based design and manufacturing tools to solve their problems and explore the wealth of innovative possibilities this technology has to offer. Many foreign governments, including China, Korea and the European Union, have already established public-private partnerships to deliver HPC to their manufacturers. Meanwhile the U.S., the world leader in HPC technologies, is lagging behind.

Broad Collaborative Support

This strategy has evolved out of NCMS's conversations with senior Administration staff, Congressional officials and Industry leaders, and specifically addresses issues communicated. The successful launch and implementation of this national innovation network requires the participation of the U.S. Government as well as the conceptual concurrence, financial commitment and direct involvement of a broad set of key industry collaborators.

More than 25 industry users and providers have already committed to the strategy, from large OEMs to smaller manufacturers, key HPC industry providers, and academia - this growing alliance has recognized the need for adoption and have committed themselves to the NCMS PIC strategy.

A Proven Collaboration Model

Since 1986, the non-profit National Center for Manufacturing Sciences has been the leader in working with manufacturers and technology providers to drive innovation and support global competitiveness. Every NCMS collaborative effort drives relentlessly toward successful commercialization of innovations. Managing collaboration is both art and science – our role is that of a catalyst. Our network allows us to bring together organizations with similar needs and our collaborative model ensures smooth project operation, intellectual property protection, risk/cost management, and successful commercialization.

Manufacturing is the most fundamental industry in any successful modern economy. A country that cannot *make things* cannot compete globally. Nor does it end with manufacturing. Nations must also constantly innovate: develop new products, new processes for designing them, and tools for building them. Just as the advent of steam power marked the beginning of the Industrial Revolution, and the appearance of the assembly line sparked the engine that drove the dawn of the modern age, a new game changer has appeared, and the United States must commit to it with the same energy and passion that drives the national interest.