Role of Illinois HPC Innovation Cluster in Job Creation and Reform of STEM Education

This document describes the mission of a Center of Excellence (COE) in manufacturing in a high performance computing innovation cluster. This COE will be located at Oakton Community College.

1. What is the market need for this project and why is it not being addressed in the private sector? Who are the major customers whose needs are not being met and will be the focus of the project?

The value of High Performance Computing to manufacturers is described in the 2004 survey by the Council on Competitiveness Study of US Industrial HPC Users (http://www.compete.org/images/uploads/File/PDF%20Files/HPC_Users_Survey%202004.pdf). The report describes how "nearly 100% of the respondents indicated that HPC tools are indispensable, stating that they would not exist as a viable business without them or that they simply could not compete effectively. A majority (70%) of the respondents indicated that HPC is so important that their organizations could not function without it." These needs are most recently addressed in federal legislation introduced by William Lipinski within the America Competes Reauthorization Act (http://www.hpcwire.com/offthewire/COMPETES-Reauthorization-Bill-Passes-Congress-112356094.html). This legislation states that "the utilization of high-end computing simulation and modeling by large-scale government contractors and Federal research entities has resulted in substantial improvements in the development of advanced manufacturing technologies; and such simulation and modeling would also benefit small- and medium-sized manufacturers in the United States." Therefore, the Act concludes, "It is the policy of the United States to take all effective measures practicable to ensure that Federal programs and policies encourage and contribute to the use of high-end computing simulation and modeling in the United States manufacturing sector." The need to provide this access to Small and Mid-sized Manufacturers (SMM) is also described in the National Center for Manufacturing Sciences survey entitled "Transforming the Way America Builds" (http://www.ncms.org/EmailBlast/2010HPCEvent/RevitalizingMFG.pdf) that reports on how 95% of the 300,000 US Manufacturers are characterized as SMMs. "If they wish to remain innovative and competitive, SMMs are in desperate need of advanced modeling and simulation tools." The survey goes on to say that "70% of respondents have the primary design responsibility for their products. Respondents ranked "high product quality" highest among criteria of importance to their business strategy, and cited the need for improved efficiency in production."

Current estimates are that there are 20,000 nanotech workers in the market today. The National Nanotechnology Initiative (NNI) reports (www.nano.org) that the US National Science foundation claims that there will be a need for 15 million workers within the next 15 years. The National Nanotechnology Initiative is one of the largest federal interagency projects promoting a future in which the ability to understand and control matter at the nanoscale leads to a revolution in technology and industry that benefits society. The Initiative coordinates the funding for nanotechnology research and development among twenty-five federal departments and agencies. Federal funding on nanotechnology has increased from $464 million in 2001 to $1.5 billion in fiscal 2009. According to estimates, private industry is investing at least as much as the government.

2. What are the services that will be offered by the Center to meet this need?

Education and consulting on HPC use for manufacturers as applied to prototype development. Education on nanomanufacturing as applied to emerging development opportunities for local small to midsized businesses within Community College's district. The Center will also facilitate interaction between those technology vendors wishing to participate in this initiative, and the leaders of the local municipalities represented within Community College's district. The purpose of this interaction is to obtain commitment of these firms to move within this district to better facilitate their market & sales efforts. We are finding the attraction of a Regional Based innovative technology offering leveraging HPC offerings from a Cloud platform to be extremely enticing to a select number of participating vendors.

3. Who are the major partners in the project and what role will each partner play?

Community College – education, coordination of grant process
All Cloud vendors (Microsoft, SGI, IBM, Amazon, Google, Dell, HP, SAP etc…) – provider of consulting and cloud use services
MARC3 – curriculum consultant and recruitment partner to manufacturing community
NanoInk – curriculum consultant
Universities – transfer opportunities and baccalaureate access
High Schools (NSERVE) – curricular pathways to job markets and baccalaureate access
US Rep. Jan Schakowsky – grant collaboration and political support
IL Sen. Susan Garrett – grant collaboration and support
IL Sen. Jeff Schoenberg - grant collaboration and support
IL Rep. Dan Biss - grant collaboration and support
IL Rep. Robyn Gabel – grant collaboration and support
District municipal offices – grant collaboration and support

4. What is the organizational model? In particular, will the Center be operated under the college or a separate organization (e.g., non-profit) and who will purchase and own the equipment?

The College will purchase and own equipment for the training of district employees. A regional STEM advisory committee will provide input regarding emerging technician employment opportunities that should be addressed by the new curriculum. The Center will promote an outreach program that invites regional manufacturers to learn how HPC can invigorate new production processes and how nanotechnology can enhance collaboration with vendors and manufacturers.

5. What is the revenue model? How will the Center generate revenue based on the value it creates for customers and stakeholders? What is the revenue needed across the first 12-24 months of ramp up to cover capital requirements and operating costs and how will that revenue be generated? How will the revenue be generated to sustain the project after ramp up and cover ongoing operating costs?

Both Community College and MARC3 will recruit potential manufacturers to the program. Community College will do so by offering curricula that surveys the nanotech and HPC tools and hardware available. MARC3 will do so by offering expertise as a service from cloud vendors including software rental and hardware cycles for production purposes. Revenue estimates and operating costs will be determined as part of the full implementation with funding of the FEDERAL grant.

6. What are the education and workforce development objectives of the project and how will students be recruited, trained and employed? Who are the expected partners in this aspect of the project?

Workshops – sponsored by Community College and The Security Board with participants from leadership roles from a select number of local businesses. These workshops would continue to raise the visibility of cloud, biotech and nanotech resources within manufacturing, education and related fields as well as define the intent of the pilot project, in this case aimed at demonstrating HPC and nanotech capacities within manufacturing.

District STEM Advisory Committee – Community College would reach out to local vendors and form a transfer curricular advisory committee that would provide support for decisions that impact the quality and activity of Community College's STEM programs that traditionally transfer to the University level. Committee members would represent various STEM curricula that the College offers and would be charged with:

1) Keeping the college informed of emerging technologies and innovations and how they align with industry needs so that Community Colleges can adapt their curriculum to meet the needs of future job markets and academic requirements for transfer programs. , and
2) Avoiding competition with existing career advisory committees that provide support to the career programs within the College.

Pilots – With full implementation upon funding by the FEDERAL grant, the project would serve as a template for a community college and businesses to plan, execute, and evaluate a pilot chartered. The Security Board in conjunction with a Community College Pilot Resource Pool staff would help the pilot through its activities. The final evaluation, facilitated by the Security Board and the College would be the gate through which the destiny of the pilot would be determined: become an on-going service, change or iterate the pilot for continued learning, or conclude activity.

On-Going Services – With full implementation upon funding by the FEDERAL grant, Community College, commercial businesses and the STEM advisory committee would contract for those value offering services decided to be retained coming out of pilots. These business services would be operated/coordinated by the Security Board and staffed

by Community College Pilot Resource Pool staff that conduct these pilot activities and now know their businesses.

The Security Board will develop a Support Team, in collaboration with the Community College to:

1) Provide assistance to those businesses requiring guidance to take full advantage of HPC and nanotech capabilities,
2) Simplify steps required by companies requiring productive HPC and nanotech access,
3) Provide HPC resources directly to the company, and provide them access to consulting relationships with domain expertise,
4) Provide packages making it easier for startup and smaller companies to 'get their feet wet' by trying out computational resources with minimal risk, administration and latency,
5) Offer a 'one-stop' shop for manufacturing companies computational and software needs,
6) Create an economic driver through development of "Domain Specific" application software necessary for the end user to be immediately productive. This "HPC Cloud Brokerage Service" is a market opportunity that Community College could potentially leverage upon successful solicitation to additional federal grants that would place a production (rather than construction) modular data center at the College.

Curricula - With full implementation upon funding by the FEDERAL grant, the development of 5 curricular models under grant support represent a starting point to respond to the needs of local manufacturing
1) Nanotechnician within manufacturing fields – address the market needs for lab technicians, repairs, sales and installation of nanotech companies who are hiring overqualified workers for these responsibilities. NanoInk and other nanotech and biotech manufacturers in Community College's district would participate in this aspect of the curricular development.
2) Modular data center (MDC) construction – curricula to train students on how to create and repair the HVAC, electrical, and fire proofing systems associated with the design and installation of MDCs. Manufacturers of MDC would participate in this aspect of the curricular development.
3) MDC maintenance – curricula to train students on how to install and update the networking, hardware and software systems associated with stable and recoverable environments with the MDCs. Cloud vendors would participate in this aspect of the curricular development.
4) HPC software survey – curricula that introduces students to the software that is capable of exploiting the novel architectural features of the MDCs as a prelude to engaging in expertise as a service consulting practices. Cloud consultants with

expertise on HPC applications in STEM fields would participate in this aspect of the curricular development.

5) Technical Math sequence – curricula that provides support for the problem solving skills necessary to be successful within such careers. These courses would be taught at an accelerated pace utilizing the successful features of Community College's ROAD Math curricula. Community College mathematics faculty who are responsible for the redesign of all developmental mathematics classes at the College would participate in this aspect of the curricular development.

Corporate Relocation Advisory Program – With full implementation upon funding by the FEDERAL grant, this service will be ongoing with those "Out of Region" companies wishing to participate. As the center's success is predicated on its capability to staying ahead of the "Evolution/Revolution" of the technology curve, we have an opportunity to "Re-Define" the "Technology Adoption Life Cycle" by way of these Centers. Done correctly, these activities create the essence of a "Win Win" for both manufacturers/creators of technology solutions as well as all users. To do this we must establish a continually evolving regional "Brain Trust" of both users & providers of product & service into this market place. Proximity to the epicenter of this effort can provide the greatest opportunity for those who believe in this vision. The fostering of a "Community within a Community" will support the "Self Sustainability" features we want. These services will continually "Match" firms getting involved with those executives that run the municipalities making up the school's district.