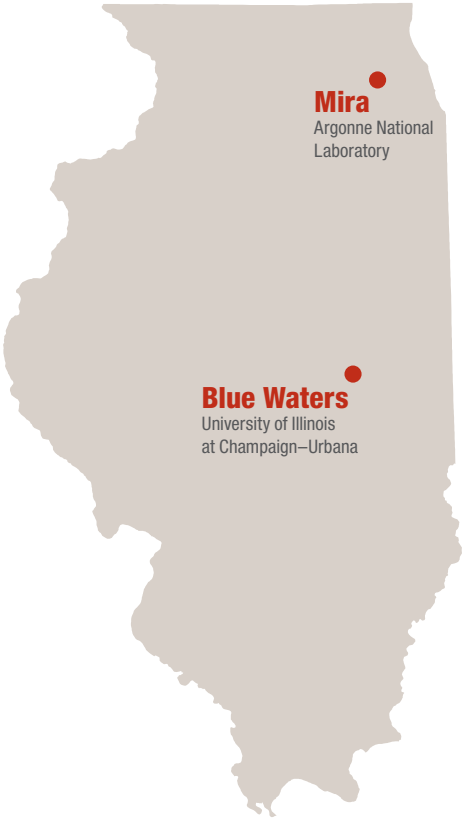
Illinois' High-Performance Computing Advantage

Accelerating innovation and economic growth through advanced modeling and simulation

Global competition and the demand for safer, higher-quality products are transforming what companies need to compete. In order to innovate at the highest, most complex levels, companies of all sizes across industries need access to the tools of **high-performance computing** (HPC). Using HPC, manufacturers like Caterpillar and Boeing are able to test new machines and models before building them; drug companies can discover new therapeutic solutions by simulating millions of molecular interactions; and financial companies can model thousands of risk factors. Simply put, tomorrow's breakthroughs will be made possible by very powerful computers.



Illinois is at the forefront of extreme-scale supercomputing, data storage and networking, and has a community of researchers with deep expertise in making real-world applications work on cutting-edge machines. Two of the world's fastest computers are located in Illinois—**Argonne National Laboratory's Mira,** currently the world's third fastest supercomputer, and **Blue Waters at the University of Illinois' National Center for Supercomputing Applications (NCSA),** which possesses the greatest sustained processing power and largest storage capacity. These world-class HPC assets allow academic and industry scientists to model and simulate previously intractable real-world problems in manufacturing and other sectors.

In addition, Illinois' high bandwidth networks and unparalleled cyberinfrastructure hold the promise of unprecedented access to and utilization of HPC. The dedicated dark fiber **I-WIRE** network connects HPC facilities at Argonne and Illinois' major research universities and industry partners, while the state's **StarLight networks** are already enabling e-Science applications that make possible new kinds of collaborative projects.

Key Industrial Applications of HPC

Illinois is uniquely positioned to benefit from the industrial application of HPC thanks to a critical mass of user companies in key Illinois industries. HPC can be applied in:

Biotechnology

for genomics research and drug development that tailor pharmaceutical products to particular patients

Food Manufacturing

for weather modeling and improved agricultural and food processes that reduce costs and improve nutrition

Clean Technology

for green energy solutions through improved engineering design, more efficient combustion, and plant optimization

Advanced Machinery

to better design, optimize, and predict the behavior of higher quality products

Finance

to test and develop financial risk models

Nanotechnology

to produce novel flexible electronics made possible by modeling the deposition of nanomaterials

HPC's Benefits to Industry

Using HPC, industries are able to innovate more frequently, reduce costs, and improve efficiency. HPC-enabled advanced modeling and simulation can:

Reduce Time to Insight

In order to better understand the risk of global financial exposures, JPMorgan simulates risk using HPC, which enables the company to obtain timely insights into ever-changing data.

Shorten Time to Discovery

FMC, one of the world's largest chemical manufacturers, discovered a way to produce safer pesticides by using HPC. Advanced simulation revealed interactions between different compounds and isolated the building blocks of insect growth enzymes and their target sites.

Accelerate Product Development

The design for Boeing's 787 Dreamliner was completed in record time by using HPC. It took Boeing only 7 prototypes for the state-of-the-art 787 wing, compared to 77 prototypes used for the 767 wing.

How HPC Helps SMEs Compete

To enhance their global competitiveness, leading manufacturers such as Boeing, GE, Nokia-Siemens, John Deere, and Caterpillar are already using HPC via NCSA's Private Sector Program and Argonne's Leadership Computing Facility (ALCF). However, as a study by the Council on Competitiveness indicates, OEMs need a nimble supply chain of small and medium sized enterprises (SMEs) to deliver rapidly on requests for new components.[1] This is possible only by utilizing HPC. Using HPC, SMEs can:

Satisfy Demand for Complex Components

Through HPC, component manufacturers can digitally model components for increasingly complex machines, while ensuring components work as needed before shipping them to OEMs.

Maintain a More Integrated Supply Chain

The more rapidly OEMs innovate, the greater the need for a quick turnaround of new component parts. Advanced modeling and simulation enables SMEs to design new components with more confidence and without redundant physical testing.

Expand and Diversify Their Product Line

SMEs with access to HPC can expand production to other highly engineered products. For instance, an SME aerospace supplier could take on work in wind turbine design and manufacturing.

ILLINOIS SCIENCE & TECHNOLOGY COALITION

info@ISTCoalition.org

www.ISTCoalition.org

[1] Council on Competitiveness. "Benchmarking Industrial Use of High Performance Computing for Innovation." p.4, 2008

Manufacturing's Digital Revolution

HPC is revolutionizing manufacturing and Illinois is leading the charge. Companies large and small can now drive competitiveness by digitally modeling components and assembling products without having to create multiple physical prototypes. Linking HPC with product design and production radically increases innovation, improves quality and decreases time and cost.

The $120 million Department of Energy-funded **Joint Center for Energy Storage Research (JCESR)** at Argonne National Laboratory brings together a network of industry, academic and national lab partners to create new breakthroughs in energy storage, including modeling the design and efficacy of new battery materials.

The $320 million **Digital Manufacturing and Design Innovation Institute (DMDII)** and its 70+ partners will apply cutting edge computing technologies to address the manufacturing challenges faced by the Department of Defense and transform manufacturing across the country.

Simulation of a complete helicopter combustion chamber performed on the IBM Blue Gene/P supercomputer at the ALCF. Image courtesy of Pierre Wolf, Turbomeca and CERFACS.