



Industry Developments and Models

HPC Accelerates Innovation for Small and Medium-Sized Businesses

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IDC OPINION

The worldwide market for high-performance computing (HPC) servers, storage, software, and support services has skyrocketed from about \$2 billion in 1990 to \$21 billion in 2015, en route to an IDC forecast \$31 billion in 2019. One important factor driving this growth has been the proliferation of HPC among small and medium-sized businesses (SMBs), especially suppliers to larger firms. In addition:

- IDC studies during the past decade have consistently shown that HPC can accelerate mission-critical innovation and competitiveness for companies of all sizes and in a broad, expanding range of markets. Despite this proof, many SMBs that might be helped by HPC remain unaware or inadequately informed about the contemporary realities of HPC, especially system prices that now start at under \$100,000 and possibilities for accessing supercomputers and HPC expertise at national HPC centers or from public cloud providers. In a sense, then, HPC adoption by the SMB community is akin to a car running with both the accelerator and brake pedals depressed.
- The good news is that a number of prominent organizations in the United States and around the world are dedicated to easing the transition to HPC for SMBs and other companies. IDC expects these efforts to pay off increasingly with greater HPC use by SMBs. This will benefit not only the SMBs and their tier 1 customers but the economies and societies where the SMBs are located.

IN THIS STUDY

This study examines the growing adoption of HPC technologies by suppliers and other SMBs to address mission-critical problems more quickly and efficiently. The study reviews the factors behind this growing HPC adoption as well as the obstacles to even faster growth in HPC use by SMBs. Another topic covered in this study is the important role SMBs play in driving innovation in a broad, growing range of markets – with case study examples included to illustrate this trend. Finally, the study offers guidance to SMBs and tier 1 companies on the value of considering HPC adoption.

SITUATION OVERVIEW

In a global IDC study, 97% of companies that have adopted HPC said they can no longer compete or survive without it. That's a powerful endorsement of this game-changing technology. The survey respondents, by and large, were tier 1 companies from a wide range of economically important markets, such as manufacturing, consumer products, life sciences/healthcare, financial services, digital content creation, and energy. Since the survey was done, HPC has extended its reach to tier 1 online companies, such as PayPal, the Apollo Group (University of Phoenix), and others. These tier 1 firms all depend heavily on HPC for mission-critical computing – typically the toughest and most consequential computing challenges they face – rather than normal business operations.

So if HPC is indispensable to those tier 1 firms, shouldn't it also benefit SMBs, including suppliers to the tier 1 companies? A decade of close scrutiny has shed much more light on the mission-critical computing needs of small and medium-sized enterprises, but SMBs are still shrouded in partial darkness. That's hardly surprising for a diverse global group with millions of members ranging from automotive suppliers and shotgun genomics labs to corner newsstands and strip mall nail salons. Many SMBs presumably will never need HPC in their lifetimes, while many others already benefit from this game-changing technology or could do so. Some SMBs are performing breakthrough work by using HPC resources at large, national HPC centers.

What Do We Know?

Let's zero in on this vibrant group that experts often credit as the principal growth engines in many economies. The manufacturing sector, for one, is replete with SMBs. The National Center for Manufacturing Sciences (NCMS) reports that within manufacturing there are 300,000 SMBs (defined as companies with 500 or fewer employees) in the United States alone. These firms account for 12 million jobs and are indirectly responsible for another 18 million – more than twice the employment of all large manufacturers combined.

Where HPC is concerned, NCMS divides SMBs into three categories (IDC research findings closely match these):

- Those that have already adopted (HPC) digital tools (~10%)
- Those that may be interested but are unconvinced or unable to adopt (~75%)
- Those that are not interested in adopting (~15%)

Details about the important minority that already use HPC resources are given in the SMB Success Stories section. Within the majority that don't use HPC resources, an interesting contingent consists of SMBs that perform technical computing on desktop systems but have not moved up to technical servers (HPC systems). Credit for initiating research on this group goes to Suzy Tichenor (now at

DOE's Oak Ridge National Laboratory) and Bob Graybill (now CEO of Nimbis Services). During their time at the Council on Competitiveness (Washington, D.C.), they collaborated with IDC to investigate these "desktop only" users. The key findings from those 2007-2008 studies are largely applicable today:

- In many cases, the companies' desktop computers were not meeting their advanced requirements, resulting in reduced competitiveness. They responded to this dilemma by scaling down the problems to fit their desktop systems, ignoring the problems, or reverting to much slower, more expensive physical testing and prototyping.
- 40% of the organizations were already planning or actively considering the move to HPC servers.
- The chief barriers to HPC adoption were inadequate understanding, the absence of internal HPC expertise, the perceived lack of "strategic fit" software, and budget constraints. Some SMBs we interviewed said moving to servers would boost annual ISV software licensing costs from under \$10,000 to nearly \$50,000.

The "Bottom 100,000" Buy a Lot

There was a time, 25-30 years ago, when buying a supercomputer meant spending \$10+ million. Today, thanks mainly to the incorporation of commodity technologies, prices for HPC systems start at well under \$100,000. The price democratization has been instrumental in expanding the size of the global HPC market from about \$2 billion in 1990 to \$21 billion in 2015.

A decade or so ago, a mega-IT company announced plans to enter the HPC market and target not the heralded top 500 supercomputer sites (www.top500.org), but "the bottom 100,000." The plan did not succeed, but it made some sense. Although the world's 500 biggest machines steal much of the limelight in the world of supercomputing, they represent less than half of 1% of the approximately 110,000 HPC systems sold around the world each year.

In 2015, HPC systems sold for less than \$250,000 each accounted for \$5.8 billion in revenue, about half (51%) of the \$11.4 billion in worldwide HPC server revenue. At an average price of only \$63,510, the sub-\$250,000 systems consumed 1.8 million processor parts, 53% of 3.4 million processors shipped last year, according to IDC research. SMBs are not the only firms that buy sub-\$250,000 HPC systems – but that's where most SMB buyers of HPC gear reside.

Alternatives to Purchasing

Purchasing systems is not the only option open to SMBs wanting to do HPC, of course. Public cloud computing can be an attractive alternative for SMBs that haven't invested in on-premise HPC resources for their cloud-friendly workloads. We know of SMBs that are doing very well, thank you, by relying entirely on public clouds. Still other SMBs turn to large, national HPC datacenters for more powerful computing resources and expertise. A major advantage these centers typically offer is access not only to powerful HPC systems but also to HPC experts who can help SMBs run their problems on these supercomputers.

Among the world's premier national HPC datacenters, none has deeper experience with industrial firms of all sizes than the High Performance Computing Center Stuttgart (HLRS). HLRS Director Michael Resch explained that his center, situated in the heart of Germany's auto industry, is seeing increasing demand for HPC from SMBs. Especially in this region, SMBs serve as technology solution providers for larger companies. Increasingly, these large clients require a validation of their technology through simulation. In certain fields, simulation can play a crucial role but is not well known inside tier 1

companies. Very small companies with very special knowledge in modelling and simulation make a living in these small market niches, but they need access to large-scale systems for the computational part of their portfolio.

Vertical De-Integration: SMBs as Innovators

As just noted, SMBs sometimes understand the value of HPC-based simulation (and advanced analytics) when many tier 1 companies in their markets do not. Advanced innovation doesn't always trickle down from big companies to their suppliers; often enough, innovation bubbles up from the suppliers.

We've certainly seen this historically in the worldwide HPC market. At the dawn of the supercomputer era in the 1960s, vendors were vertically integrated firms that had to develop (i.e., innovate) almost every technology themselves because there was little useful technology available in the open market. Over time, especially as the rising use of commodity technologies reduced margins, leading vendors could no longer afford to carry the whole innovation burden. They began to de-integrate, moving more innovation out to SMB suppliers. Today, innovation in the HPC industry is a vibrant mix of contributions from large and smaller companies alike. Within large HPC vendors, HPC-focused intrapreneurial business units often function as captive SMBs, augmenting the varied R&D activities of external SMB suppliers.

SMB Success Stories

As the real-world examples in the sections that follow illustrate, SMBs in a range of markets are using HPC resources to help drive innovation that can have a profound positive impact on our economies, our societies, and the quality of human life.

America's Truck Fleet: Targeting \$19 Billion in Fuel Savings

BMI Corp. is using time on the massive "Jaguar" supercomputer at Oak Ridge National Laboratory to redesign the classic tractor-trailer ("semi") truck for greater fuel efficiency. (BMI has also been using the supercomputer for design work on NASCAR racing cars, a hydrogen fuel cell concept car for Ford, a new supersonic business jet, and a winglet for the Boeing MD-80 regional airplane.) Today's tractor trailers have an average drag coefficient of 0.59 and get only 5-6mpg at highway speeds of 65mph. BMI's goal in launching the Smart Truck project is to reduce the drag coefficient to 0.26. If all 1.3 million long-haul trucks operated at 0.26, the trucks would average 10mpg and the United States would save 6.8 billion gallons of diesel fuel annually, eliminate 75 million tons of CO₂, and rescue \$19 billion in fuel costs. To date, the researchers have brought the drag coefficient down to 0.33, most of the way toward their goal. Running this extremely complex simulation takes 1.4 years (501 days) of processor time, but the Oak Ridge supercomputer can handle the problem in just a few hours.

Pediatric Cancer: Someday a Fast Genomic Diagnosis for Every Patient

The Center for Pediatric Genomic Medicine at Children's Mercy Hospital, Kansas City, Missouri, has been using supercomputer power to help save the lives of critically ill children. In 2010, the center's work was named one of *Time* magazine's top 10 medical breakthroughs. Roughly 4,100 genetic diseases affect humans, and these are the main causes of infant deaths. But identifying which genetic disease is affecting a critically ill child isn't easy. For one infant suffering from liver failure, the center used 25 hours of supercomputer time to analyze 120 billion nucleotide sequences and narrowed the cause of the illness down to two genetic variants. This allowed the doctors to begin treatment with corticosteroids and immunoglobulin. Thanks to this highly accurate diagnosis of the problem and

pinpoint treatment, the baby is alive and well today. For 48% of the cases the center works on today, supercomputer-powered genetic diagnosis points the way toward a more effective treatment. For the other 52%, the HPC-based simulation doesn't lead to a cure, but it lets parents know that they can avoid subjecting their critically ill child to further difficult tests and treatments. The center's five-year goal is to provide a fast, accurate diagnosis for every critically ill child that comes under its care.

Accelerating Designs for Sports Equipment

PING Golf is a privately held sports equipment firm that depends for 80% of its annual revenue on new products, so PING must continually innovate to compete and survive. Before the company adopted HPC, it had to outsource the construction of prototypes and then test them. This repetitive process could take up to a year. With virtual prototyping on an HPC system, PING can design superior products much faster and fine-tune designs with optimization. PING's flagship products are titanium drivers. If they need a weld, simulations help decide where to put the weld and must be accurate to within thousandths of an inch. Thanks to simulation, PING has never had to redo a weld on a product. PING also does HPC simulation for aerodynamics. The drag from the club head could slow down the drive, so PING has to design the head to minimize drag. PING's iron for the Japanese market required testing of how two materials would work together, and the iron took only two weeks to design. The company also performs simulations of wedges, on where to place the center of gravity on the club face, because this makes a big difference.

Supercomputer Simulation Enables 20 Vehicle Designs per Year

Automotive and aerospace supplier Swift Engineering reports that the new breed of affordable, sub-\$100,000, easy-to-deploy computers made the transition to HPC relatively easy and highly worthwhile. The SMB's customers include Toyota, for which Swift helped develop the aerodynamic shape of the Tundra truck and the NASCAR version of the Camry; Northrop Grumman, for which Swift developed the Bat Unmanned Aerial Vehicle; Eclipse Aviation, for which Swift developed and built a new, light business jet in only 200 days; and others. The company says it can design a vehicle in one season that would take a big OEM up to four years. (Swift makes prototypes, not certified production vehicles like the ones Northrop and others build.) With the HPC system, Swift can model 20 vehicles a year. Among the HPC benefits, Swift cites that the company gets three to four times more work done with its two HPC clusters while spending 20-30% less on computing. Even more important, Swift is doing things it couldn't do before and is deepening its understanding of customers' automotive and aerospace problems.

A 12-Person Company Tackles Global Markets

RECOM Services, a 12-person SMB based in Stuttgart, Germany, started out doing combustion modelling for large-scale power plants and now does designs and process optimization for a wide range of industrial furnaces and boilers. This minute company could not justify buying an HPC system and instead performs simulations on supercomputers at the nearby High Performance Computing Center Stuttgart. This has enabled RECOM to grow revenue quickly, including recent moves into the U.S. and Asian markets.

3D Movie Animation on Budget, on Time

M.A.R.K. 13 is a 45-person German media company focused on designing movies. This business requires swift reaction time and extremely high quality. When approached to do work for the Australian-German animated movie based on the internationally known book "*Maya the Bee*," M.A.R.K. 13 entered into a collaboration with HLRS to guarantee high-quality, on-time production of

3D pictures for the 79-minute movie. Although the movie only required about 1% of HLRS resources, it could not have been done without high investment costs by such a small company. Using HLRS resources not only helped speed up the works but also substantially reduced the financial risk for the customer.

FUTURE OUTLOOK

Across the globe, government leaders increasingly recognize that HPC can boost industrial and economic competitiveness and that SMBs can play a strong part in this transformation. As a result, industrial partnerships have been proliferating in programs at the U.S. Department of Energy's national laboratories and National Science Foundation centers, within Europe's PRACE initiative, and at leading HPC organizations across the Asia/Pacific region. A fair amount of this activity is directed at SMBs, which are the most numerous and, in some geographies, the largest enterprises.

The sobering news is that despite strong growth in HPC use among SMBs, substantial obstacles continue to impede even faster growth. Chief among these is the inadequate understanding of HPC and its potential advantages within many SMBs (and tier 1 companies) that might benefit from this transformational technology. Other important obstacles include the archaic perception that moving to HPC means spending millions of dollars for a supercomputer. As noted previously, prices for HPC systems now start at well under \$100,000 and purchasing a system is not the only option. SMBs can apply for time on supercomputers at national HPC centers, or they can turn to public clouds if their workloads are cloud friendly.

The good news is that SMBs will continue to get more attention, including additional research to illuminate some of the remaining dark corners of this market segment. IDC, for example, recently began what we believe will be the most ambitious effort yet to identify and characterize HPC-related ROI at large numbers of these organizations. And organizations such as the Council on Competitiveness, the National Center for Manufacturing Services, NCSA's Industrial Partners Program, PRACE, HLRS, Teratec (France), Hartree Center and EPCC (both in the United Kingdom), the Shanghai Supercomputer Center (China), and others are hard at work aimed at easing the transition to HPC for SMB organizations.

ESSENTIAL GUIDANCE

- **Both tier 1 firms and SMBs should investigate the benefits of HPC.** HPC is a game-changing technology for SMBs and tier 1 companies alike. Research and case studies have consistently shown that the use of HPC can transform companies of all sizes, heightening their ability to innovate and be competitive. Historically, HPC has been exploited mainly by companies that need to model and simulate physical phenomena – cars and planes, oil fields, pharmaceuticals, electronics and appliances, sports equipment, and more. But tier 1 financial services companies began using HPC systems for advanced analytics in the 1980s, and today, HPC-based data analytics ("big data") is spreading to other sectors, including online tier 1 companies and SMBs. Tier 1 firms and SMBs should evaluate whether HPC can help them. They risk losing ground in the marketplace if competitors learn how to exploit HPC before them.
- **Many SMBs that might benefit from HPC can afford to try it out.** The assumption that moving to HPC requires buying a multimillion-dollar supercomputer is archaic. HPC system prices start today at well under \$100,000. Many national and regional HPC centers have industrial

outreach programs that offer time on their supercomputers and help in using them. SMBs can also avoid capex associated with purchasing HPC equipment by running cloud-friendly workloads in public clouds.

- **Tier 1 firms and their suppliers can gain additional competitive advantage by coordinating their HPC use.** For tier 1 firms that manufacture complex physical products, such as cars or airplanes, coordinating HPC use means using the same software applications and the same overall models. This enables the tier 1 manufacturers to plug the parts designs directly into the designs for the overall vehicles. An analogous process can be used for drug designs, digital content creation (e.g., animated movies and special effects), healthcare data management, and many other industrial/commercial processes.

LEARN MORE

Related Research

Related research from IDC includes the following documents:

- *The Formative Market for High Performance Data Analysis: Big Data Meets HPC.* Global study for a private client. April 2015
- *High Performance Computing in the EU: Progress on the Implementation of the European HPC Strategy.* IDC interim report for the European Commission Directorate-General for Communications Networks, Content & Technology. E. Joseph, S. Conway, R. Sorensen. March 2015
- *HPC Speeds Innovation for Suppliers and Other SMBs* (IDC #252680, November 2014)
- *EESI-2 Special Study To Measure and Model How Investments in HPC Can Create Financial ROI and Scientific Innovation in Europe* (IDC, August 2014)
- *Creating Economic Models Showing the Relationship Between Investments in HPC and the Resulting Financial ROI and Innovation – and How It Can Impact a Nation's Competitiveness and Innovation* (IDC #243296, October 2013)
- *Clouds for Science and Public Authorities – Final Report for the European Commission.* SMART 2011/0055. August 2013
- *An Assessment of the Likely Supercomputers Available in 2017.* Global study for a private client, based on in-depth interviews with more than 40 HPC technology vendors from throughout the world, concerning their plans and opinions on technology futures. June 2013
- *NSF/NCSA Special Investigation of HPC Applications Used in Industry: Their Usage and Needs and the State of the Art in the Science Underlying the Algorithms* (IDC #236250, August 2012)
- *Science and Supercomputing: New Capabilities Illuminate Nature's Unending Complexity.* S. Conway, IDC. HPC Source. SC11 Special Edition, November 2011
- *Financing a Software Infrastructure for Highly Parallelized Codes – IDC FINAL Report for the DG Information Society of the European Commission* (IDC #SR03S, July 2011)
- *A Strategic Agenda for European Leadership in Supercomputing: HPC 2020 – IDC Final Report of the HPC Study for the DG Information Society of the European Commission* (IDC #SR03S, September 2010)

Synopsis

This IDC study examines the growing adoption of HPC technologies by SMBs in economically important markets to address mission-critical problems. HPC has demonstrated its ability to elevate innovation and competitiveness in companies of all sizes. The rising use of commodity technologies has made HPC systems affordable for many SMBs, but inadequate understanding of HPC's potential benefits has prevented HPC use among SMBs from growing even faster than it has.

"Today, more and more SMBs, as well as tier 1 firms, are adopting HPC technology to tackle mission-critical problems more quickly and efficiently," said Steve Conway, IDC research vice president for High Performance Computing. "Companies that could benefit from HPC use should investigate this game-changing technology or could lose ground to competitors that do this first."

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