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HPC Directions In Manufacturing: Using Simulation To Gain Competitive Advantage

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The global market for high-performance computing (HPC) servers has experienced strong growth each year since 2003. In 2007, sales of HPC servers reached US\$11.6 billion. IDC estimates that worldwide sales of HPC systems in the manufacturing sector made up about US\$1.5 billion of this total. In addition, many servers are used in the government sector for computer-aided engineering (CAE) work (approximately US\$500 million in additional sever revenues). Revenue growth on the computational side has been driven almost entirely by clustered servers that provide new levels of price/performance. Clusters recently crossed the 65% market share line to become the dominant species of HPC servers. At the same time, there are a number of customer pain points in the manufacturing sector, including growing software license fee costs, power, cooling and performance on manufacturing-related application codes.

The following questions were posed by representatives of Cisco, Hewlett-Packard, Intel, and Microsoft to Earl Joseph, Program Vice President of IDC's High-Performance Computing practice, on behalf of the companies' HPC customers.

Q. How important are HPC-based simulation and modeling for manufacturing firms?

- A. An IDC study for the Council on Competitiveness in Washington found that manufacturing firms that use HPC consider it indispensable for their ability to innovate and compete (the full report is available at: <http://www.compete.org/>). High performance computing is not only a key tool for increasing competitiveness, it is essential for business survival. About 97% of the surveyed firms indicated that without HPC tools, they could not exist as viable businesses or compete effectively. A growing variety of companies use virtual prototyping in manufacturing.
- Boeing, for example, used HPC systems to perform virtual prototyping in many design areas for the highly successful Boeing 787 "Dreamliner" aircraft. The company needed to test only 11 wing designs for this plane, versus 77 wing designs for the earlier Boeing 777 plane.
 - A small gear design company is winning more design bids by including a simulation analysis with its proposals that identifies likely failure and stress areas. The proposals also show how these simulations improve the initial designs to make parts more durable.
 - Proctor & Gamble employed virtual prototyping to solve an important manufacturing problem. This enabled their Pringles potato chips to stop flying off the assembly line, and instead to "fly" into their cylindrical containers. P&G has used HPC technology in conjunction with other products, including Pampers diapers and plastic coffee canisters.
 - Whirlpool found that an unacceptably high percentage of its washing machines were being dented between the factory and the retailer. Through HPC-based virtual

prototyping, the company saved millions of dollars by redesigning packaging materials and even the clamps used by the firm's global network of shippers.

- A Japanese automotive company is using advanced HPC to design cars that can last 150,000 miles on average without any repairs.

Q. What are the major HPC-related trends in the manufacturing sector?

- A. Product release schedules are shrinking dramatically. Historically, automotive manufacturers released new models every five years. Now that time frame is close to 18 months and shrinking. Using HPC and complex modeling, including shared-collaborative modeling software to make changes on the fly, a manufacturer can shorten their design schedules. And with new technology, the design can automatically be uploaded to the manufacturing floor to drive the tooling for the new designs as well.

Small and medium-sized businesses are moving to HPC and require "ease-of-everything": reference architectures with pre-integrated, pre-tested, standards-based elements, including the hardware/interconnect switch and software ranging from the operating system to the middleware and applications. Small and medium-sized manufacturers are specializing in the products they make. They are also being forced to integrate their operations into those of the large component assemblers that they are designing and building products for. By integrating HPC with collaborative tools such as TelePresence, the design time frame can happen quickly and without the delays that are inherent in a non-connected manufacturing value chain.

Other important HPC trends in the manufacturing sector include the following:

- HPC use is growing, as are the number of problems being solved, and problem complexity and concerns.
- A complete switch has occurred from vectors and RISC-based technologies to clusters using standard technologies.
- Software application costs are rapidly increasing.
- Clusters are affordable, but are complex to deploy and manage.
- There is a growing concern about how well future technologies will work on existing applications, without having to fundamentally redesign application software.

Q. What are the major barriers to progress?

- A. Many of the important barriers are directly related to HPC trends in the manufacturing sector. The barriers vary, based on the size of the firm and the length of time that they have been using HPC. Typical barriers, however, include the skyrocketing cost of application software. For larger firms the ISV software costs exceed the hardware costs, often by a factor of two or more. For smaller firms, the yearly ISV costs are getting harder to justify. Application performance on new systems is becoming more challenging with scaling, multicore concerns, and the need for application software that works on each company's specific jobs. In addition, issues related to cluster system management and complexity affect nearly all firms, as do the data explosion and data management difficulties, and the need for more training and knowledge (for example, the ability to configure and order the right system).

Q. How important are industry-standard technologies/solutions and easy-to-use GUIs?

- A. Industry-standard technologies now dominate the HPC market, including the manufacturing sector, for a number of reasons. First, their price is dramatically lower,

allowing more firms to use HPC. Second, standard technologies make systems easier to learn and use. Third, standard technologies provide a larger range of options and choices. Finally, standard technologies make computer simulations far more cost-effective than doing physical engineering tests. Hence, systems with industry-standard technologies such as x86 processors, standard operating systems and interconnects, and reference architecture implementations, are what the market is buying. Off-the-shelf ISV applications are heavily used in manufacturing. Vendors providing better ease-of-use and better GUIs are best positioned to exploit the IDC-forecasted market growth in HPC in general, and manufacturing in particular.

Q. What do manufacturing firms look for in an HPC systems vendor?

A. First, they prefer vendors that understand users' CAE problems and can provide them with guidance on which solutions are best for their unique problems. Price and price/performance are still king for the larger and more established firms, but for smaller and new-to-HPC firms, ease-of-everything is driving their requirements.

Performance on their specific applications is always critical for well-established firms, whereas for smaller firms, help in getting their applications working effectively on HPC servers is key. Application software and middleware are crucial for manufacturing sites, and certification that simulation results match reality is also important for most sites. This makes strong, collaborative customer relationships increasingly important. Local channels are also very important to many buyers.

In addition, power, cooling, and density are now major attributes used in many purchase evaluations. And a good Web site helps – bundled packages help to make purchases of today's increasingly complex HPC systems easier. Training and good support services are also important for many sites.

ABOUT THIS ANALYST

Earl Joseph, Program Vice President of IDC's High-Performance Systems, drives research and consulting efforts associated with the United States, Europe and Asia/Pacific markets for technical servers and supercomputers. This research includes market sizing, market share, segmentation, tracking, trending, and vendor analysis for the multi-user technical server technology.

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