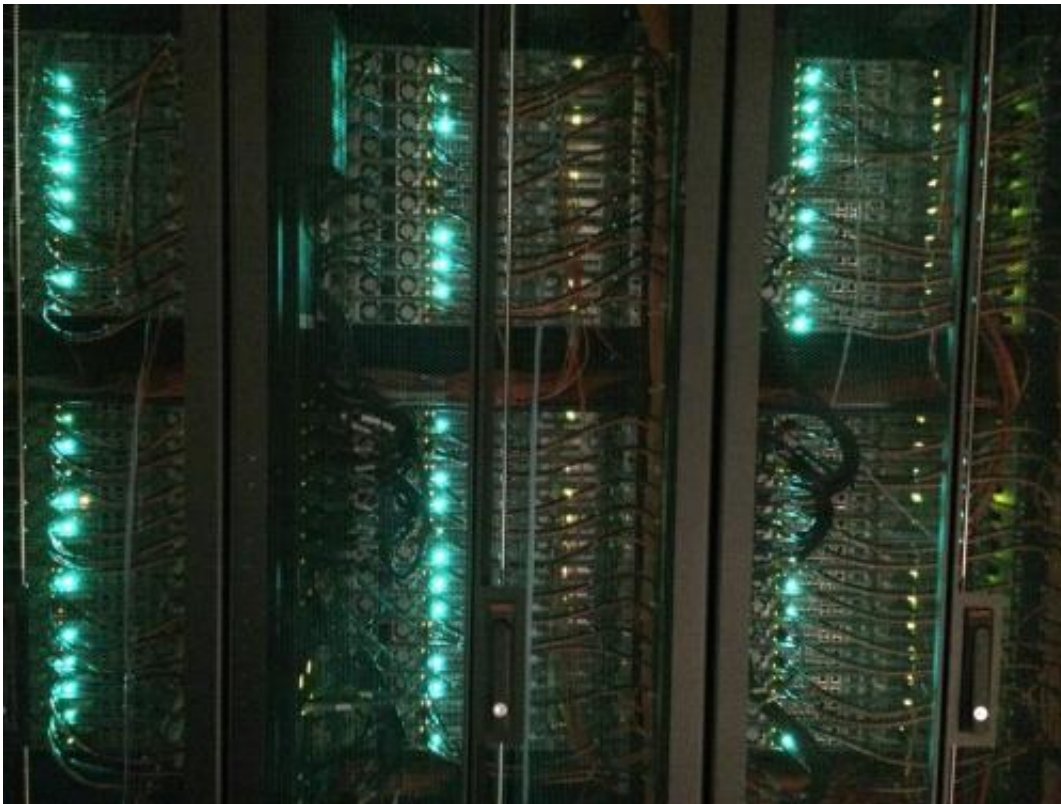# Supercomputers give universities a competitive edge, researchers find

March 23 2015, by Paul Alongi

A supercomputer that can do 551 trillion calculations per second is housed at Clemson's Information Technology Center.

Researchers have long believed that supercomputers give universities a competitive edge in scientific research, but now they have some hard data showing it's true.

A Clemson University team found that universities with locally available supercomputers were more efficient in producing research in critical fields than universities that lacked supercomputers.

A supercomputer that can do 551 trillion calculations per second is housed at Clemson's Information Technology Center.A supercomputer that can do 551 trillion calculations per second is housed at Clemson's Information Technology Center.

While the cost of supercomputers is easy to quantify, their benefits have been less understood, researchers said.

Previous reports have shown anecdotally that the United States is more competitive by investing in high-performance computing. The Clemson research was the first of its kind to put numbers behind the assumption.

"For the nation, it is unequivocal that a high-performance computing system will provide an advantage in doing research in several fields," Amy Apon said. "It's not uniform across all fields. But for fields where it matters, it matters a lot."

Apon, who led the study, said the fields that benefited the most were chemistry, civil engineering, physics and evolutionary biology. The study used a National Research Council survey of 212 institutions, including 177 universities with high or very high research levels.

Authors of the study were Apon, Paul W. Wilson, Linh B. Ngo and Michael E. Payne.

Wilson, the lead economist on the study, said the research begins to give policymakers data to consider as they decide whether supercomputers make economic sense.

"The project contributes not only to science and innovation policy, but also to cyber-infrastructure investment decisions," he said.

"While many would agree that high-performance computing has a positive effect on research output, the connection has been assumed and qualitative until now," he said. "This is a critical first step in creating a model for evaluating investments in high-performance computing."

The results were encouraging to Jim Bottum, who oversees the Palmetto Cluster as Clemson's chief information officer and vice provost for computing and information technology.

The Palmetto Cluster ranked as the sixth fastest supercomputer at public universities in the United States, according to the November edition of the Top500 list.

"The study's results reaffirm that computing is centrally important to research and a wise investment that helps the nation maintain its competitive edge in science, engineering and technology," said Bottum, who was not involved in the research.

As part of the study, universities were divided into "haves" and "have-nots." The universities in the "haves" list were those that had supercomputers in the Top500 list, and the have-nots were the rest.

Researchers considered "input" and "output" variables that affect efficiency.

Input variables were the total number of faculty members and incoming graduate students' average GRE scores, which were used as a way of measuring of students' capabilities.

The "output" variables were the total number of publications for the

academic year and the number of Ph.D. degrees awarded.

The biggest effect was in chemistry, where haves were estimated to be almost twice as efficient as have-nots.

In civil engineering, haves were found to be about 35 percent more efficient than have-nots.

Differences between haves and have-nots in evolutionary biology and physics were smaller but statistically significant. In particular, haves were estimated to be about 11 and 9 percent more efficient than have-nots in the two disciplines, respectively.

The efficiency levels estimated by the researchers give a measure of how close observed research output is to feasible, potential research output.

Apon is chair of the Computer Science Division in the School of Computing. She previously founded and ran a high-performance computing center at the University of Arkansas.

The study is titled, "Assessing the Effect of High Performance Computing Capabilities on Academic Research Output" and was published in *Empirical Economics*.

Eileen Kraemer, the C. Tycho Howle Director of the School of Computing, said that the research highlights Clemson's strengths in data-enabled science and high-performance computing.

"The research provides statistical evidence and some quantification," she said. "This should give decision-makers some important information as they allocate funding."

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Provided by Clemson University